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OPHTHALMIC

SURGERY AND TREATMENT:

WITH

ADVICE

ON THE

USE AND ABUSE OF SPECTACLES.

BY

JOHN PHILLIPS,
OPTICIAN AND OCULIST.

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PREFACE.

So great an amount of talent and industry has of late years been devoted to the investigation of Diseases of the Eye, that a new volume on the subject appears to require a few words of introduction.

Notwithstanding all the assistance the student may derive from systematic treatises and pictorial instructions, close personal examination of a large number of patients can alone enable him to recognize those delicate changes which the tissue of the eye presents under various morbid conditions. Specially to direct his attention to these changes, and to explain the best methods of observing them for himself, is the primary object of the following pages.

I have, therefore, chiefly dwelt on the description of *outward* phenomena; for, inasmuch as the peculiar susceptibility of a patient must cause endless modifications of his *subjective* symptoms, a full consideration of these would have expanded my volume, from its present moderate dimensions, into a System of Ophthalmic Pathology.

I have endeavored to describe accurately and simply the appearance of the various tissues of the eye, both in health and in disease; and, after 30 years' practice as practical optician and oculist, and recorded in essays, periodicals, etc., in this country and Great Britain, by far exceed in practical importance those made in any other branch of medical science.

I shall consider this book to have attained its object if to the student it renders ophthalmology intelligible and useful, and if to the practitioner it affords a faithful record of the present state of this branch of medical science.

The matter contained in this book being, however, in great part derived from the labors of others, and adapted by myself to the requirements of men in general practice, it is necessary to mention here the books which should be read by those who wish for more ample information on the subjects treated, and to state the nature of the more important innovations in ophthalmology.

Among periodicals, should be consulted—"The American and London Ophthalmic Hospital Reports, and Journal of Ophthalmic Medicine and Surgery;" and "The Ophthalmic Review, a Quarterly Journal of Ophthmalmic Surgery and Science."

Among continued publications must be mentioned—A periodical published by Professor DONDERS, of Utrecht.

No ophthalmological work, however, more deserves the attention of the medical men in general practice, or that of the oculist, than the one translated by W. D. MOORE, M.D., Dublin, etc., W. MACKENZIE, M.D., C. BADER, C. STELLWAG, M.D., J. DIXON, J. Z. LAURENCE, and H. W. WILLIAMS, M.D.

The ophthalmoscope, in its simplified form, has come into general use, and has proved indispensable to the oculist, as well as to the medical man in general practice. It not only enables us to view the retina, optic disk, etc., in health and disease, but often also affords the earliest means of recognizing the presence of general morbid changes, such as albuminuria, syphilis, cerebral tumors, etc. A knowledge of the mode of using the ophthalmoscope may be acquired within a few hours, and richly repays the philosopher as well as the physician.

Among the numerous works upon the changes of the retina, choroid, etc., which have appeared since the invention of this instrument, must be mentioned "A Practical Treatise on the

Use of the Ophthalmoscope, etc., by J. W. HULKE, F.R.C.S.," and the "Atlas of Ophthalmoscopic Drawings, with Text, by Dr. LIEBREICH, of Paris."

I have not entered into any criticism in the course of the work as regards the medical, surgical, or optical treatment of affections of the eye.

To Dr. FOWLER I must also pay my tribute of thanks and admiration; and no less to my friend Dr. LORD, of Springfield, Illinois, who has greatly assisted me by many suggestions, during keeping the Infirmary for four years in Springfield; and also to Dr. J. B. WALKER, Dr. RALLS SMITH, and Dr. UNDERWOOD, of Chicago, who have greatly assisted me in many important suggestions, during keeping the Infirmary twelve years in Chicago. Also to Dr. DAVID PRINCE, Jacksonville, Ill.

I am under obligations to others, whom I name not in detail, that I may escape the charge of parading the catalogue of my kind friends. To all and each I tender my warm and respectful thanks.

I shall in this place, however, take the opportunity of making a few remarks upon the more important changes which ophthalmology has undergone in reference to diagnosis and treatment.

A service of great importance has been rendered to ophthalmology by Mr. JONATHAN HUTCHINSON's researches in infantile syphilis. These have shown a very frequent form of *corneitis*, hitherto described as strumous, to be one of the numerous symptoms of inherited syphilis.

The treatment of affections of the lachrymal passages has been rendered much more simple and successful by Mr. BOWMAN'S operation of slitting open the lachrymal puncta and canaliculi, and by his adopting a series of large probes and other instruments in the treatment of obstructions and strictures of these passages. The operations, as well as the necessary instruments, have come into general use.

The Operation for Strabismus.—The two methods of operating most frequently adopted are that termed the subconjunctival method, and that by which an incision is made into the conjunctiva over the tendon, the latter drawn out of the wound and divided close to the sclerotic, and the conjunctival incision united again by a suture. The latter mode of operating, known as V. GRÆFE's method, is generally practised on the Continent, and has found advocates in this country. Mr. CRITCHETT was the first to operate by the subconjunctival method at the Eye Infirmary, Moorfields, where this mode of operating is maintained by most of the surgeons. More practice is required to operate by the subconjunctival method, and I have found that beginners obtain better results, and succeed with greater facility, by the other mode of operating, though I prefer the subconjunctival method. The treatment of strabismus (convergent as well as divergent) by the application of atropia, together with the use of proper spectacles, has of late been adopted in many cases with great success, since Prof. DONDERS has shown the connection between strabismus and its cause, *viz.*, the anomaly in shape of the eyeball.

Operations for the Removal of Cataract.—Instead of the usual mode of removing soft cataract by absorption, many surgeons adopt the operation of linear extraction, or remove the cataract by suction (an operation which was first extensively practised by Mr. PRIDGIN TEALE, JUN., of Leeds), as a quicker method of restoring vision. Both methods, if the cataract is fluid or very soft, may with safety be employed by any one. If the cataract is glutinous, much experience and manual dexterity are required, to avoid the complications arising from attempts at rapid removal.

The innovations introduced for the removal of hard cataract refer chiefly to the application of chloroform, to the operation of iridectomy, and to the extraction of the cataract by artificial means, and through a smaller or differently shaped section. As regards the question of chloroform, many differences of opinion exist, and I shall confine myself to stating that, for the last four years, I have been in the habit of giving chloroform to every patient with cataract, whatever his general health or age may have been, if from his manner, or from his behavior while examining the eye, or from existing increased tension of the eye, I had any doubt as to the complete passiveness of the patient, or of his eyes, during the operation. Only in one case out of nearly 200 did hemorrhage occur into the vitreous chamber after the operation, during vomiting; and, in this case, I had doubts whether the bandage applied had not been disturbed.—[BADER.

As regards the performance of iridectomy, the result of the experience of those who operate by extraction, without giving chloroform, is, that the risks of losing vitreous humor are more numerous; and that it is preferable not to perform iridectomy, but to wait, and to remove the prolapse of the iris by iridectomy whenever it shows itself after the operation. For removal of cataract with the scoop, iridectomy is indispensable. Though vision is less acute, even if the iridectomy "is made upwards," than when the pupil is circular, yet it is, as a rule, sufficiently good to admit of the usual occupation of the patient. A comparison of the results obtained, when removing cataract by simple extraction, with those when removing it "under chloroform" with the scoop, or by other artificial means, combining with the operation an iridectomy, shows, according to statistics published by others, that a smaller number of patients obtain useful vision by the operation of simple extraction.

This statement, I believe, holds good only if the operator has obtained equal dexterity in both modes of operating. More practice and a more thorough knowledge of the physical properties of the parts within the eye are required for the success of the scoop operation. The complications which may present themselves, during certain stages of the operation, are more numerous.

The Operation of Iridectomy.—This operation was introduced into practice in 1856, by Professor GRÆFE, of Berlin. Its influence upon the morbidly-increased tension of the eyeball led him to adopt it in glaucoma. The operation has become generally established. Its *modus operandi* is not yet understood, but it has proved the remedy by which the largest number of patients suffering from glaucoma are relieved.

The operation of division of the ciliary muscle was first practised by Mr. HANCOCK, and performed by him, and others, for glaucoma, as well as for other morbid changes not accompanied by, or not caused by, undue tension of the eyeball.

The Operation for Iridesis, or Iridodesis, introduced by Mr. CRITCHETT, is preferred by some to the old operation for artificial pupil.

The Operation of Excision of the Eyelid, in its present simplified form, was first brought into practice at the Eye Infirmary, Moorfields, by Mr. CRITCHETT.

The Acuteness of Vision, and the State of Refraction and Accommodation of the Eye, are, as a rule, ascertained by test types, *i.e.*, by a series of different definite sizes. The most perfect of the kind are those published by Dr. SNELLEN (Dr. H. SNELLEN. "Test Types for the Determination of the Acuteness of Vision. New Edition. Printed by P. W. Van de Weyer, Utrecht, Holland. 1866").

Though, in the course of this book, it is shown how to make use of common letters, when ascertaining the acuteness of vision, etc., it is very desirable that those who are engaged in the study of ophthalmology should procure Dr. SNELLEN's test types.

In most Continental works the decimal system is employed for the expression of linear measure. In this system the unit is called a mètre, and expresses the ten-millionth part of the meridian arc passing through Paris, and extending from the north pole to the equator.

A mètre is equal to 39.3707904 English inches. Hence, we have a decimètre, equal to 3.93708; a centimètre, equal to .0393708. By those who wish to convert metrical into the present English lineal measure, the following mode may be adopted:—Let it be required to express fifteen millimètres (=15^{mm}) in English inches. Since one millimètre =.0393708 English inches, 15 millimètres =15×.0393708 English inches, =.590563, or =$\frac{59}{100}$, or $\frac{6}{10}$, or $\frac{3}{5}$ inch, nearly.

To convert English inches into French millimètres:—Since one mètre =39.37079 inches, therefore one inch =$\frac{1}{39.37079}$ mètre =.02539954 mètre =25.39954 millimètres =25.4 millimètres nearly. *Ex.*—How many millimètres are equivalent to 3¾ inches? 3¾ inches =3¾×25.39954=95.24827 millimètres. If we assume 1 inch =25.4 millimètres, then 3¾ inches =3¾× 25.4, or 95.25 millimètres.

The sign ′ is used for foot, ″ for inch, and ‴ for line (or $\frac{1}{12}$ of an inch). Thus, distances of 5′, 5″, 5‴, signify distances of five feet, five inches, and five lines. The same sign (′) as for the notation of foot, and the sign ″ for the notation of inch, is used in other books, the former for angular minutes, and the latter for angular seconds. It is therefore better (and it is mostly practised in the different subjects) to write the denominational word after the number—thus, instead of 5′, 5″, 5‴, we write five feet, five inches, five lines.

In the course of each subject, those abbreviations are given which are generally accepted by modern ophthalmologists. To save trouble to the reader, however, the words which are represented by those abbreviations have been printed in full. It was thought necessary to give those abbreviations, since in many essays, etc., on ophthalmological subjects, they are made use of without explanation.

I conclude with the expression of my sincere thanks to those whose valuable advice and assistance have been so freely rendered me in the preparation of the following work for publication. My thanks are especially due to my friends.

JOHN PHILLIPS.

January, 1869.

INTRODUCTION.

Every one who examines or attempts to treat of the interesting subject of vision, finds himself compelled to exclaim in terms of highest admiration of the superior beauty and contrivance of its inimitable organs, the eyes. Whether we take into consideration the brilliancy of structure so remarkable in that organ, the complication and rapidity of its movements, or its exquisite sensibility, we are equally astonished and delighted.

We have said that it is the most beautiful of all organs of the senses; it is, likewise, the most important and, therefore, the most valued. All the other organs are necessary to the well-being of the individual, but there is none so essential as that of vision. It is, evidently, the great inlet to the higher road of knowledge. It is capable of imparting to the mind information relative to objects so vast that the other senses cannot grasp them, and of bodies so minute as to elude the most delicate and refined tact. It recognizes objects, whether placed in the immeasurable wilds of space, or at a distance of a hair's breadth.

Possessing such power, we perceive that it is with justice that the eye has been termed the "window of the soul." Its importance is further apparent, when we consider what a lengthened, tedious, and unintelligible account we receive in words, which, if directed to the eye, either actually or by representation, would be comprehended in all its bearings. Thus, we shall often obtain more information concerning objects at a single glance, occupying but an instant of time, than by a whole hour's description addressed to the mind through the ear. To many mysterious things must a blind man give credit, if he will believe the relation of those who can see.

It requires no argument to prove that the loss of so important a function as that of vision is one of the greatest misfortunes that can befall us. It would appear still more incredible to such beings as we have supposed, if they were informed of the discoveries that may be made by this little organ, in things far beyond the reach of any other sense. That, by means of it, we can find our way on the pathless ocean, traverse the earth, determine its size and figure, measure planetary orbs, and make discoveries in the fixed stars. Would it not appear still more strange to these beings, if they should be further informed that, by means of this organ, we can perceive the temper, dispositions, affections, and passions of our fellow-creatures, even when they most desire to conceal them; that, by this organ, we can often perceive what is straight and crooked in the mind, as well as the body; that it participates in every mental emotion, the softest, as well as the most violent; that it exhibits these emotions with force, and infuses into the soul of the spectator the fire and agitation of that mind in which they originate.

It is not, therefore, without reason, that the faculty of seeing is looked upon as a more noble one than the other senses, as having something in it superior to sensation, as the language of intelligence, the evidence of reason, so-called; not feeling, smelling, tasting; nay, we express the manner of the divine knowledge of seeing, as that kind of knowledge which is most perfect in ourselves.

ADVICE ON THE EYE

AND ITS

DISEASES.

IMPERFECT SIGHT.

There is no branch of science of which it is more important that a general knowledge should be diffused, than that branch which treats of the various imperfections of sight, and the remedies for them.

To relieve an organ which is the source of the most refined pleasure, is certainly a desirable object. To determine whether spectacles will be advantageous or detrimental, and what kind will best suit their sight; and so instruct those who already use glasses that they may discover whether those they have chosen are adapted to the imperfection of their sight, or are such as will increase their complaint and weaken their eyes, are subjects worthy the consideration of every individual, and constitute the principal business of this work. To this end, we shall, in the first place, explain what we mean by imperfection of sight.

We here understand by imperfection of sight, an absolute or relative debility of it, without any opacity, either in the cornea or other internal part of the eye, and without disease of the retina or the optic nerve.

The sight is relatively imperfect when we cannot see an object distinctly in a common light, and at the usual distance at which it is observed by an eye in the perfect state. In this sense, both the long and the short-sighted are said to have imperfect sight. The short-sighted see distant objects confusedly, those that are near at hand distinctly; their sight is, therefore, defective with respect to distant objects. On the other hand, the long-sighted see distant objects distinctly, and near objects confusedly. An imperfect sight is caused by a confusion in the image formed upon the retina. This happens when all the rays that proceed from any one point of an object are not united again in one, but fall upon different points of the retina; or whenever several pencils of light, from different points of an object, terminate upon one point of the image.

This species of confusion takes place both in long and short-sighted eyes. An imperfect sight differs from an amaurosis or gutta serena; for in the latter, the sight is entirely lost, and the pupil becomes immovable; though if one eye remain sound, the pupil of the blind eye will move with the pupil of the sound one; but if the sound one be shut, the pupil of the blind eye will be destitute of its motion.

SHORT-SIGHTEDNESS.

Short-sightedness is that state of vision in which a person can see objects perfectly, only when they are at a very short distance from the eyes; nine inches, or less, being the greatest distance at which objects can be plainly seen. It is owing either to too great refractive power of the refractive media of the eye, or to the distance of the retina behind the crystalline being too great; so that in either case, rays of light come to a focus before arriving at the retina, cross, and are in a state of dissipation, when they do impinge on the nervous membrane, and therefore form indistinct and confused images. By bringing the object near the eyes, it is distinctly seen, because the rays from it, which enter the eyes, being now more divergent than when it was at a distance, are not so soon brought to a focus; in other words, the different points of the object, as foci of incident rays, and the focus to which these rays are brought in the interior of the eye by the refractive media, to conjugate focus, and accordingly, when the foci of incident rays are brought nearer the refractive media, the foci of refracted rays recede from them.

Too great a refractive power of the media of the eye may be owing either to too great a convexity of their curvatures—the curvatures of the cornea and crystalline—or too great refractive density, or both conjointly.

The situation of the retina at too great a distance behind the crystalline body may be owing either to a preternatural elongation of the eyeball, or to the lens being nearer the cornea than usual.

In short-sightedness, the power of adjusting the eye to different distances is still retained, but within certain limits, thus: the nearest distance may be from two to four inches, the furthest from six to twelve inches.

The peculiarities of short-sighted persons are: 1st. They see small objects more distinctly than other people, because, from their nearness, the objects are viewed under a longer visual angle.

2d. They see them also with a weaker light, because the object being near, a greater quantity of rays from them arrive at the eye. Hence, they can read small print with a weak light.

3d. But they can also see more distinctly, and somewhat further off, by a strong light than by a weaker one, because the pupil is contracted by the strong light, and all but the more direct rays of light thereby excluded. On the same principle, they see at some distance distinctly through a pin-hole in a card; and when they try to view distant objects, they half close their eyelids. The rays of light in these cases have their divergence at the same time somewhat increased by diffraction.

4th. They sometimes see objects beyond the limit of their distinct vision, double, and sometimes multiplied.

Subjects of Short-sightedness.—This defect of vision seldom occurs in so great a degree before puberty as to be troublesome; when in a great degree in children, it may be a symptom of a central cataract.

After puberty, when the eyes come to be used in earnest, short-sightedness is usually first discovered to exist, and it may go on gradually increasing, especially if a person use his eyes much in reading, and on minute objects; as the greater frequency of short-sightedness among the educated classes and those whose occupation with minute objects will show.

Myopia sometimes occurs in old persons, whose vision was previously good for ordinary distances.

To persons whose occupation is with minute objects, short-sightedness, unless in a very great degree, is rather an advantage, as they are enabled to observe all the details of their work very accurately; and in the ordinary exercise of vision, the use of concave glasses is a ready and simple help.

When a tendency to short-sightedness manifests itself in young persons, and especially if the future occupation of the person is to be of a kind requiring good vision for distant objects, much exertion of the eyes on minute work should be avoided, and the eyes exercised on large and distant objects.

Concave glasses help the vision of short-sighted persons for distant objects, simply by increasing the divergence of the rays of light before they enter the eye, so that they may be less speedily brought to a focus than they would otherwise have been, in consequence of the increased refractive power of the media of the eye; or, supposing the refractive power of the media of the eye not increased, but the distance of the retina behind the lens increased, that they may be brought to a focus at a greater distance behind the lens than it would otherwise have been, in order to correspond with the greater distance of the retina behind the lens. Concave glasses are made of different degrees of concavity; the shallower being those adapted for the slighter degrees of short-sightedness, the more concave for the greater degrees.

When very short-sighted, a person requires the use of concave glasses, not only to be enabled to see distant objects, but also for reading with, in order to avoid the necessity for stopping. Less short-sighted people use glasses only to see distant objects.

The focal length of the concave glass which a person will require to see objects at more than two or three hundred yards distance, should be equal to the distance at which he can see to read distinctly an ordinary type with the naked eye six inches, for example.

The focal length of a concave glass which a very short-sighted person will require to read at a convenient distance is determined thus: suppose he can see to read with the naked eye at the distance of six inches, and desires to be able to read at the distance of twelve, the one distance is to be multiplied by the other, and the product, seventy-two, divided by the difference between the two distances, *viz.*, six. The quotient, twelve, is the number of inches the focal length of the glass required should be.

The following are the circumstances which should guide him to his choice:

The glasses should be the lowest power which will enable him to distinguish objects as he wishes, quite readily and clearly, and at the same time comfortably. If they should make objects appear small and very bright, and if in using them the person should feel his eyes strained or fatigued, or if he becomes dizzy, and if, after putting them aside, the vision is obscure, they are not fit for his purpose, as they are too concave. Having once fitted himself, a person should not too hastily change his glasses, although they may appear not to enable him to see quite so clearly as when he first used them. A glass to each eye should always be used; vision is by this means clearer, and its exercise less fatiguing to the eyes, than when a glass to one eye only is used. The use of a glass to one eye only is, in fact, very detrimental, especially to the opposite eye.

Appearance presented by the Eyes of Myopic Persons.—In many cases, there is nothing peculiar to be observed; but frequently the eyes are prominent and firm, the cornea very convex, the anterior chamber deep, the pupil dilated, the crystalline lens more convex, and the "pigmentum nigrum" more diluted and of a higher color.

TREATMENT.

There is a peculiar condition of sight liable to be mistaken for myopia, but which I am inclined, with Dr. Walker, to refer to a congenital weakness of the retina. Such persons cannot see distant objects as well as other people; but they can distinguish tolerably large distant objects better than small ones, and the effort required to make out small type is frequently productive of fatigue in the eyes. As they habitually approach objects nearer the eyes than natural, they pass for near-sighted people. But these are the points of difference: a true myope, having found his points of distinct vision, can read or write for any length of time, without fatigue, and can see clearly, even in a feeble light. This vision of distant objects, too, is materially assisted by the use of concave glasses.

The amblyope (as the other may be called, from the dulness of his sight,) always requires a strong light, and that only for a short time. Concave glasses, instead of assisting, rather confuse his vision, and diminish objects. Convex glasses of a low power, on the other hand, rather assist him.

In such cases, slightly magnifying glasses may, by increasing the dimensions of small objects, diminish the fatigue of the eyes; but they should not be granted without due caution. I have known instances of children having been punished for supposed stupidity, they not learning to read as quickly as others, but slowly and with many mistakes, blundering over their spelling. This really depends, in some cases, on imperfect sight, and the child, with every desire to do his best, is unable to distinguish the letters quickly. In these cases, encouragement, rather than punishment, is needed; the child should have large type, plenty of light, and not be kept at his lessons too long at one time; his general health should be strengthened, and the eyes and head freely bathed in cold water two or three times a day, and twenty drops of muriated tincture of iron twice a day. The question often arises, as to whether young boys should be sent to public schools. I am quite of the opinion that those laboring under defective vision should not. For, being physically unable to compete with other boys, they are placed in a false position; whilst it is quite impossible that they can receive from the masters that patience and attention necessary for their advancement. Thus, they are kept back in every respect, are laughed at by schoolfellows, and the unfair character of dunces allotted to them.

That a power of adjusting the focus of the eye to different distances exists in the healthy eye, is proved as follows:

Let a person place a couple of thin objects fifteen or twenty yards asunder, in a line with one eye (the other being shut), and let the nearest object be a yard from the eye; on fixing the eye on the nearest object, he will perceive the distant one to be indistinct, and on looking at the distant object, the near one will become indistinct; and on each change of the object of the vision he will become conscious of an alteration in the adjustment of the anterior of the eye.

If, then, a person employs himself for long periods together, and that for successive days, in reading, microscopical observations, or other pursuits requiring close application, he becomes, not strictly near-sighted in the general acceptation of the term, for he does not hold objects much nearer the eyes than usual, but he finds that he discerns distant objects less and less distinctly. In fact, he finds that the eyes being exercised so much in adjusting the focus for near objects, lose the power of adjustment to the focus for distant objects.

The prevalence of concave spectacles among the Americans, who are great readers, is proverbial; and many must have noticed the same prevalence at our universities. Mr. Ware found, out of 127 students in one college in Oxford, 32 who used either a hand-glass or spectacles. Indeed, I believe that few persons of studious and sedentary habits entirely escape the consequence of their labors. The public are little aware of the extent to which the studious, and those who live by the exercise of their intellect, suffer from imperfection of sight.

Many instances have fallen under my notice, of poor students and writers whose poverty compelled them to pursue their literary avocations in the gloom of dusky apartments, or by the aid of a dim candle, and who have become myopic and amblyopic in consequence. And scarcely less numerous, are those who, though pursuing their labors under more favorable circumstances, are equally visited with this affliction. It would appear that even the study of ophthalmic science may cause the same penalties to be paid; for M. Desmarres informs us, that one of his pupils became very myopic by exerting his eye too much in the diagnosis of diseases of the eye; a sad result of most rare industry!

The progress of this infliction is generally by insensible degrees, and it often happens that the person in whom it is commencing is warned of it more by his own feeling than by the remarks of others, who notice that, when studying or regarding objects, he holds his face nearer than it was his wont. After a time, however, he is sensible that he cannot distinguish distant objects as quickly as formerly; that the eye does not seize them at once, and when seen they are indistinct; and when the affection has made still more progress, they cannot be seen at all. If, in the very earliest stage, a low convex glass be held to the eye, vision is rather assisted; but when the abnormal condition is established, convex glasses cease to render aid, and concaves are required.

If this affliction is induced in an adult, whose eyes have been previously strong, it may be overcome without much difficulty, if taken in time; but when the subjects of it are feeble, strumous youths, in whom the intellectual powers are more vigorous than the bodily, and who have, perhaps, suffered in infancy from constitutional weakness of the eyes, the case is much more unmanageable, and the prospects of cure much less favorable.

The popular idea that the eyes of near-sighted persons are rendered fitter for seeing as they advance in years, is not borne out by experience. The subject has been investigated by Dr. Walker, whose astute mind is well qualified for such inquiries, says: "It has been very generally, if not universally, asserted by systematic writers on vision, that the short-sighted are rendered by age fitter for seeing distant objects than they were in their youth; but this opinion appears to me unfounded in fact, and to rest altogether upon a false analogy. If those who possess ordinary vision when young, become, from flatness of the cornea, or other changes in the mere structure of the eye, long-sighted as they approach old age, it follows that the short-sighted must, from similar changes, become better fitted to see distant objects.

It is generally supposed that the short-sighted become less so as they advance in years, and the natural shrinking and decay in the humors of the eye lessen its convexity, and thus adapt it better for viewing distant objects; but among the great number of short-sighted people that I have accommodated with glasses, I have never found the reverse of this theory to be true, and the eyes of myopes never required glasses less concave, but, generally, more concave, as they grow older, to enable them to see at the same distance.

I have lost no opportunity of inquiring of myopic persons whether their sight had improved, and I cannot call to mind a single instance in which the reply was decidedly in the affirmative. One case, especially, occurs to me: A lady, 82 years of age, who is a patient of Dr. Walker's, told me that, as long as she could remember, she had used No. 8 myopic glasses, and that, with them, she could read the smallest type and thread a needle with the greatest facility; but, most decidedly, her sight had not changed, as to focus, within her recollection. I examined her eyes and glasses very carefully, and satisfied myself of the power of the latter.

One of the most frequent questions of patrons at my office is, "Do you think, sir, that spectacles will be of use to me?" It matters little whether the sight be impaired by overwork, by congestion, by debility, or by opacities of the cornea; the same idea is current in the minds of the poor. They often try them, and if they do not find assistance from ordinary spectacles, they take to colored glasses, green or blue, as an improvement on the former. I need scarcely say, unless really called for, spectacles do more harm than good; and, for reasons hereafter to be given, such colored glasses are *inadmissible;* not only are they injurious and exciting complimentary colors, but they are apt to render an eye over-susceptible to light, and if there be retinal congestion, it cannot fail to be aggravated by the additional effort to see objects but dimly illuminated; therefore, in cases where the sight is impaired, but where no intolerance of light exists, the habitual use of colored glasses is highly objectionable.

I have noticed that young persons, about the age of puberty, after severely trying their eyes upon minute objects, as in painting, embroidering, and the like, suddenly become short-sighted. They and their friends are alarmed at their being no longer able to see objects on the opposite side of the street, which a few days before they were able to distinguish with ease. The effort necessary for seeing small objects is attended with pain, and, instead of fifteen or twenty inches, at which the patient used to read, the book must be brought as near to the eyes as six or eight inches. Sudden myopia is most apt to occur in boys sent to learn such trades as watchmaking or engraving, or in young ladies at school occupied with music, painting, embroidering, and other pursuits requiring continued and keen employment of sight. In these cases, the intense application has temporarily paralyzed, as it were, the adjustment to distant objects, and the proper course to pursue is, to give the eyes rest for a few days, when they will recover their natural condition. Frequent bathing of the eyes with cold water will relieve any congestion of the vessels. I have also found great relief by applying concentrated tincture of capsicum, by rubbing it for a few minutes, daily, over the forehead and temples with a sponge; but care should be taken not to allow it to enter the eye.

The circumstance of eyes differing in their focal length is a common occurrence, and needs but a few words on the proper course to be pursued. There is a very general impression that one eye is stronger than the other, the right being supposed to be the strongest, partly, perhaps, from its being preferred for looking at objects when one eye only is required, as in taking aim in shooting, using a microscope or telescope, etc. Convenience has much to do with this, the right arm and the right eye corresponding in action; when, however, there is really a difference in the vision of the eyes, it may be found how far this depends on the focal length, by placing an open book at the ordinary reading distance.

We also occasionally find that one eye will be myopic and the other presbyopic, a condition of vision embarrassing both to the patient and to the surgeon, but the nature of which may easily be ascertained by a careful trial with glasses, and looking at the page with the eyes alternately, the one not used being closed. Supposing, then, that the type appears distinct to the right eye but confused to the left, the book should be slowly drawn nearer, and if the focus of the left eye is shorter than that of its fellow, the type will become distinct at a certain distance; one or more inches less than the ordinary distance. To make the point more certain, the vision of the left eye can be made equal with the other, by holding before it a slightly concave glass if the difference be trifling, or a higher power if the inequality be great.

It is important to all persons, but especially to the young, and to those whose position in life requires much exercise of the eyes, that they should have the benefit of both, and that all the labor should not be thrown on one, as necessarily happens in the condition of vision under consideration, a condition sometimes produced by the carelessness of inferior opticians or the hawkers of cheap spectacles, who sell lenses of different focal lengths in frames intended for persons whose eyes are equal; or who supply those eyes in which there is an inequality in the foci with duplicate glasses, rendering, in each case, one eye useless.

In early life, the vision of the eyes may often be brought into harmony by blindfolding the perfect eye and patiently practising the other at the utmost distance, increasing that distance by small but steady degrees, avoiding rapid or vacillating changes. If this does not suffice, practise, with lenses hereafter to be described, will be proper; but if circumstances prevent the exercise being satisfactorily carried out, it will be necessary to have a spectacle frame made with a lens for the imperfect eye, just sufficiently strong to equalize the vision. The circle before the perfect eye should be blank, but, in order to counteract the weight of the lens (which would throw the frame out of its proper position), the empty side of the frame should be made heavier than the other.

Near-sighted persons are very apt to stoop while engaged in study. To avoid a practice so injurious to the figure and health, they should use a high desk when reading or writing; and if glasses are indispensable, such only should be used as just suffice to enable the parties to pursue their occupations at the ordinary reading distance, that of fourteen inches. Small type, sketchings, microscopical pursuits, and objects requiring close inspection, should be avoided; the individual should overcome his natural tendency to a cramped hand, and write boldly and freely; and be the pursuit what it may, in which he is engaged, the greatest possible distance should be maintained between his eyes and the object.

In all cases of myopia, and especially in early life, or when the affection is just commencing, it is highly important that any tendency to an over-supply to the eyes should be counteracted by a proper amount of bodily exercise, and every opportunity should be embraced for exercising the eyes on distant objects. Near-sight is comparatively rare in persons engaged in agricultural pursuits, and is almost, if not quite, unknown among those uncivilized nations whose eyes are constantly practised in nomadic warfare or the chase.

Near-sight may be acquired in early youth, by the habit common to infants, of approaching their eyes very close to any object on which their attention may happen to be engaged. Observe a group of children learning to write or draw, almost all with their faces sideways and their tongues in one corner of their mouths, nearly touching with their cheeks the paper or slate on which they are laboriously accomplishing their task. Many infants have been rendered short-sighted, and many have acquired squints, from constantly playing with toys; for, as the visual axis converges when objects are held near the eyes, frequent repetition of this may end in strabismus. And I may here remark, that strict attention should be paid to the position of an infant's sleeping cot, and to the attitude in which it is placed in its nurse's arms. The eyes of the infant ever seek the light, and many an unsightly cast has been entailed on a child by its being always placed with one and the same side to a candle or a window. The light in the nursery should not be too much on one side of the cradle, nor should a candle or lamp, in the evening, be so placed that the eyes of the child are distorted when looking at it. There is sound judgment in printing children's books in good, bold type, in encouraging them to observe distant objects, and in inviting them to describe what they see in landscapes.

Near-sighted children are often fond of books, and love to pore over some favorite story, in a quiet corner, for hours together. They should be watched, and compelled to hold their heads ten or twelve inches from the page, and the same in the schoolroom. Such children are obliged, during music lessons, to lean forward in a very unseemly manner, to distinguish the notes. To obviate this, a sliding bookstand should be attached to the piano, and should be drawn forward when the child is practising. As, however, some musical instruments will not admit of such an arrangement, spectacles of a low power may be used at that time, and at that time only; and the lesson should not exceed half an hour, without a pause of a few minutes for the eyes to rest.

Insufficiency of light in rooms where children receive instruction, or where they are taught mechanical work, is a cause of near-sight, and, occasionally, even more serious mischief. Care should, therefore, be taken that school and working rooms should be properly and sufficiently lighted.

FAR-SIGHTEDNESS.

To detail those circumstances which are, in general, marks of advancing age, and always of partial infirmity, must be ever unpleasant, and would be equally unnecessary, if it were not for the means of lessening the inconvenience attendant on those stages of life. By long-sightedness, remote objects are seen distinctly, near ones confusedly, and, in proportion, as this increases, the nearer the objects, the more indistinct they become, till at length it is found almost impossible to read common-sized print without assistance. An imperfect image is formed upon the retina, because the rays of light which come from the several points of an object, at an ordinary distance, are not sufficiently refracted, and, therefore, do not meet on the retina, but beyond it. Various are the causes which may occasion this defect: If the convexity of the cornea be lessened, or if either side of the crystalline becomes flatter, this effect will be produced; if the retina be not sufficiently removed from the cornea or crystalline, or if the retina be too near the cornea or crystalline, it will give rise to the same defect, as will also a less refractive power in the pellucid parts of the eye. In like manner, too great proximity of the objects will prevent the rays from uniting till they are beyond the retina. But if all these causes occur together, the effect is greater. This defect is, however, in general, attributed to a shrinking of the humors of the eye, which causes the cornea and crystalline lens to lose their original convexity, and become flatter. The same cause will bring the retina too near the cornea.

Another change which the eye undergoes in age, is the impairment of its power of adjustment.

As we advance in life, not only does the refractive power of the eye diminish, but we lose the power of accommodating the organ to near objects.

The eye, in its state of perfect indolent vision, is adapted only to distant objects, and it cannot see near objects distinctly but by an effort. This effort, long persevered in, becomes painful, whereas, the regarding of distant objects can be continued without any feeling of fatigue. The power to make the peculiar effort in question, is partially or totally lost by the presbyopic eye; a fact analogous to the diminished activity which takes place in all the functions of the body as life advances.

The symptoms of presbyopia, then, are: Difficulty in discerning close objects; so that a person who, in early life, could read ordinary print, with ease, at twelve or fourteen inches, is now obliged to hold a book two feet, or even further, from his eyes; and the act of threading a needle, or nibbing a pen, becomes fatiguing to the eyes, if not almost impossible, excepting when assisted by an increase of light. Employing them at fine work for any considerable length of time, induces headache and uneasiness about the brows and forehead. These symptoms may be accounted for thus: In consequence of the object being removed to a greater distance, the visual angle, the quantity of light, and the picture on the retina become smaller; so small, indeed, as to render it difficult for the retina, with its impaired sensibility, duly to appreciate it without effort and a considerable increase of light. The diminished size of the pupils, which attends declining years, increases the necessity for more light.

With this state of vision the person can see objects distinctly only when they are at a very considerable distance from the eyes; in reading, for example, he holds the book at arm's length.

Far-sightedness being in almost all respects the converse of short-sightedness, the best way of discussing it here will be to reverse the account given of short-sightedness, and which will therefore stand thus:

Far-sightedness is owing either to diminished refractive power of the refractive media of the eyes, or to the distance of the retina behind the crystalline body being too short; so that in either case the rays of light tend to come to a focus at a point behind the retina, on which, therefore, they impinge in circles of dissipation, and form indistinct and confused images.

By removing the object from the eyes, it comes to be distinctly seen, because the rays from it which enter the eye, being now less divergent than when it was near, are more quickly brought to a focus; in other words, the different points of the object as foci of incident rays, and the foci to which these rays are brought in the interior of the eye by the refractive media, are *conjugate foci;* and accordingly, when the foci of incident rays are removed from the refractive media, the foci of refracted rays come nearer them.

Diminished refractive power of the media of the eye may be owing to diminution of the convexity of their curvatures, flattening of the cornea and crystalline. As to refractive density, there is probably an increase rather than a diminution of it, but this appears to be more than overbalanced by the diminution of curvature.

The situation of the retina too near the crystalline may be owing either to a preternatural shortening of the axis of the eyeball, or a receding of the lens from the cornea.

In far-sightedness, the power of adjusting the eye to different distances is much weakened. In this respect far-sightedness differs from short-sightedness, in which the power of adjustment is still retained. In far-sightedness, it may be said that the habitual adjustment of the eye is for distant objects, and that in trying to read, for example, the power of adjustment is exerted to the utmost; hence the fatigue and confusion of vision which soon ensue.

Appearances presented by the Eyes of Far-sighted People.—In many cases, there is nothing peculiar to be observed; but frequently the eyes are sunk, the cornea flat, and of small diameter, and the pupil contracted.

Peculiarities of Vision of Far-sighted People.—1. They see small objects indistinctly at every distance, because when near they are out of focus, and when removed from the eye somewhat they are seen at a small visual angle and with little light. By increasing the light, they see better. Hence, they do not see so well by candle-light as before, and when attempting to read by candle-light, they place, perhaps, the candle between them and the book held at arm's length. 2. They see large and distant objects very distinctly. 3. In most presbyopic persons, Dr. N. Arnott has ascertained that double vision in the eyes singly exists in a slight degree.

Subjects of Far-sightedness.—Far-sightedness seldom occurs except in persons who have passed middle age, and in them it is so common, that it is to be viewed as a natural change in the state of the eye. As it occurs in young persons, it will be spoken of under the head of *Asthenopy.*

Prevention and Treatment.—Though instances have occurred of persons who have been long presbyopic, recovering their former vision, and thereby being enabled to lay aside the use of their spectacles, recovery from presbyopy is not to be calculated on; but this is of small moment, as vision can be so perfectly assisted by means of spectacles. Something, however, may be done in the way of preserving the sight by avoiding over-exertion of the eyes in reading and other minute work, especially by artificial light, at the time of life when far-sightedness, with diminution of adjusting power, usually comes on.

Convex glasses help the vision of far-sighted people for near objects, by diminishing the divergence of the rays of light before they enter the eye, so that they may be more speedily brought to foci than they would otherwise have been, in consequence of the diminished refractive power of the eye; or, supposing the refractive power of the eye not diminished, but the distance of the retina behind the lens diminished, that they may be brought to foci at a less distance behind the lens, than they would otherwise have been, in order to correspond with the diminished distance of the retina behind the lens.

Convex glasses are made of different degrees of convexity: the least convex being those adapted for the slighter degrees of far-sightedness, the more convex for the greater degrees.

To see distant objects, far-sighted persons do not, in general, require convex glasses. It is most commonly to enable them to read and do minute work that far-sighted people use spectacles.

If it is only at a *very great* distance that a person can see distinctly, the focal length of the convex glasses which he will require to enable him to read will be equal to the distance at which he wishes to see to read.

If he is not so very far-sighted, but can see small objects distinctly at twenty inches distance, for example, the focal length of the convex glasses which he will require to enable him to read at twelve inches distance, is determined by multiplying the two distances together, and dividing the product, 240, by the difference between them, *viz.:* 8. The quotient, 30, is the focal length in inches of the glasses required.

The following are the circumstances which should guide him in his choice:—The glasses should be of the lowest power which will enable him to see objects distinctly as he wishes, and at the same time comfortably. Glasses which make the objects appear larger than natural, and strain and fatigue the eyes and cause headache, are not adapted to his case—they are too convex. It is usually found that glasses the next degree more convex are required for work by artificial light.

The alteration in the eye on which the far-sightedness depends, generally goes on to increase with age; hence it is necessary, after a time, a few years, to change the glasses first chosen for others more convex. In regard to this exchange it is to be observed, that it ought not to be too hastily had recourse to, nor, on the other hand, too long delayed. The same feeling of necessity which first prompted to the use of glasses, will indicate the necessity of change.

It is a not uncommon notion that glasses of certain focal lengths are adapted to certain ages, but this is erroneous. Still, though the choice of glasses cannot be determined by the mere age of the person, there is a certain average relation between the age and the focal length of the convex glass required, which is expressed in the following table:

Age in years,	40,	45,	50,	55,	60,	65,	70,	75,	80,	85,	90,	100.
Focal length in inches,	36,	30,	24,	20,	16,	14,	12,	10,	9,	8,	7,	6.

Reading Glass.—This is a double-convex lens, broad enough to permit both eyes to see through it. It is used for the purpose of magnifying the object; whereas, convex spectacles are used merely to render objects distinct at a given distance, without magnifying them as above mentioned.

The color and consistence of crystalline humor alters with age: it is thicker, cloudy, and less transparent as we advance in years; which is one reason, among others, why many elderly people do not reap all the benefits from spectacles which we might naturally expect.

There is, usually, little in the appearance of the eyes to account for the changes. This, indeed, may be expected; for although the cornea, in the majority of cases, is, perhaps, somewhat diminished in convexity, yet it is not perceptible. The inefficiency of the eyes probably depends less on the altered form of the cornea, than upon that of any other media of the organ, especially of the crystalline lens. The eyes of an old person are commonly sunken in their sockets; but this is dependent upon the general absorption of the adipose tissue of the orbits, as well as of the body generally, which is one of the phenomena of age. It is the diminution of the aqueous contents of the globe, in combination with peculiar changes in the lens, which becomes denser and less convex, of diminished transparency, and more or less of an amber hue, which influences the refractive powers. As age creeps on, the "pigmentum nigrum" (to which the blackness of the pupil is due) diminishes in quantity, giving to the pupil a greenish or grayish hue, which, to an inexperienced eye, might be mistaken for incipient cataract or glaucoma. The cornea becomes less transparent, a white circle, called "arcus senilis," forms around its margin, the colors of the "iris" fade, and the nervous power of the eye becomes less energetic.

The period of life when presbyopia displays itself, is the same as that at which hard cataract commences; and I have seen many cases where the imperfections of vision caused by the decay of the lens has been confounded with presbyopia.

These facts make it clear that a protuberant eye is not so well constituted for vision as one that is sunk in the head; neither extreme is, indeed, desirable, yet, undoubtedly, of the two, that which is deep set is preferable, as affording the clearest sight, and being least liable to injuries from external accidents and of light.

TREATMENT.

The sun of our animal existence has been wisely ordained to travel at so slow a rate that its progress is almost imperceptible, and so ardently do we love to bask in its rays, that when Time whispers to us that he has passed the meridian, we vainly endeavor to persuade ourselves that he may have mistaken the point of his culmination.

I have already said that the failure of the sight is one of the earliest symptoms of declining years, but there is a strong disinclination to admit this failure; at any rate, we are not willing to proclaim it by adopting glasses. Their use, however, should not be deferred; for, although it is a common notion that spectacles are injurious to the eyes (and no doubt they are so, if those of an improper description be employed), yet, when the powers of the eye begin to fail, so that we can neither read nor write for any length of time without great discomfort, it is reasonable to conclude that refraining from their use is more injurious than their adoption.

2d. We, therefore, who prize the most valuable gift of nature, should be less anxious as to what others may think of our age, than for the preservation of so valuable a possession.

3d. The term "preservers," applied, as it is, to the lowest description of convex glasses, alone tends to convey the idea that if such glasses are used in time, they prevent any further changes in the eye. This is erroneous; and it is to be regretted, that the lowest magnifying power should have received that appellation, for all glasses are preservers, if well adapted to the eye; whereas, by applying that term to those particular glasses alone, thousands are induced to use them before they really require them, which is productive of injurious consequences, inasmuch as, by assisting the eye before it requires help, it encourages it to be indolent in its action. As a general rule, spectacles always act beneficially when they afford just so much assistance to the eye in its attempt at adjustment as enables it without fatigue to form a distinct picture upon the retina, rather than beyond it.

Some refrain from the use of glasses who really require their aid, from the belief that if they once begin to use them they will never be able to leave them off. In the great majority of cases, this is perfectly true; but, even then, it is better to submit with a good grace to an affliction which can seldom be averted, and to have recourse to those simple means which at once set the eye at ease and enable its possessor to enjoy many hours of comfort and rational employment, which would otherwise be lost.

Daily experience teaches us that the decay of vision is hastened by many causes, which are frequently overlooked. Although it is about the age of 40 that the sight begins to fail, yet we find some persons who attain extreme old age without needing glasses at all. Other persons, on the contrary, require glasses at the age of 30; and though much depends on constitution, much also depends upon the person's habits.

One of the worst habits, is that of overworking the eyes by candlelight. Repose from labor, so necessary for the restoration of tone and vigor to the several organs of the body, is too sparingly granted to the eyes. Some, from a desire to distinguish themselves; others, urged by necessity, encroach upon the hours of rest, and overtax the sight without mercy by lamp or gas work. To the poor, but working classes, medical treatment, when the eyes are thus oppressed, affords only temporary relief; the return to similar habits, however necessary, invariably brings back the same disease, and, by its repeated attacks, vision is sooner or later destroyed. Let us hope that the advancing spirit of the age will arrest so crying an evil.

The following remarks are addressed to the former class; to those who from motives of ambition, or from love of study, neglect those ordinary precautions, without which the eyes will inevitably suffer:

Let it be remembered that day-work is preferable to night-work; that while the light of a candle or lamp is trying even to the strong eye, the moderate light of the sun is strengthening to it. Those whom circumstances compel to study in the evening, should select that kind of work which is least distressing to the eyes. They should especially avoid indistinct writing or small print; the diamond edition, in which the print is extremely small and very injurious to the eyes.

Persons who write much, especially in the evening, should use blue wove paper in preference to that of the yellowish-white description, to which the term "cream laid" is applied. There is a paper of a deeper blue than ordinary, which is very agreeable to irritable eyes, for writing by artificial light.

Jet-black ink is far better than blue or fancy shades of purple, brown, etc. Pale ink is altogether bad, and the fair sex, especially, would do well to bear in mind that they would show the most kindly consideration for their correspondents and benefit their own sight, by using good black ink, and, I may add, writing legibly.

Red ruled lines, when in any number on a page, are objectionable.

It is wise to change the position occasionally, during hard study; to write, sometimes standing, and other times sitting; and to break the labor, now and then, by walking about. The simple plan of raising the eyes from the sheet or page and fixing them for a few seconds on the cornice at the other side of the room, so that the adjustment of vision may be altered, cannot be too strongly recommended.

Persons with feeble sight or irritable eyes should not sleep with their couches facing the window, nor should their writing-tables be in that position. There is another thing to be especially avoided by such parties, namely: reading whilst traveling in a railroad carriage. The peculiar vibration imparts an unsteadiness to the page which is most trying to the eyes, and more than one person, to my knowledge, has suffered from this thirst for knowledge, during daily journeys to and from the town.

Reading by firelight, or simply gazing at the fire when sitting alone, or in a contemplative mood, is highly injurious to feeble eyes, and should be avoided by all. It is not advisable to read by twilight; too little light is as pernicious as too much light. Yet, many persons, evening after evening, try their eyes in this way, rather than burn a candle or lamp.

It is injurious to the eyes to be long exposed to the reflection of a strong light, whether artificial or natural, such as the reflected sunshine from the page of a book; too brilliant a light produces undue excitement of the eyes. Travelers in African deserts find it necessary to protect these organs from the sun's rays by a piece of crape. The inhabitants of some Eastern countries, for the same purpose, anoint the edges of the lid and the eyelashes with a black pigment, composed of oxide of antimony and oil, which has the effect of subduing the light, and, at the same time, improving the personal appearance.

The inhabitants of the Arctic regions ingeniously protect their eyes from the light reflected from the snow, by wearing in front of the eyes a long and thin piece of wood, perforated by two long horizontal slits, one corresponding to each eye. By means of this simple contrivance, just such a quantity of light is permitted to enter the pupil as will suffice for vision.

To preserve weak eyes as much as possible from a strong light, neutral tint spectacles are preferable. Many physicians recommend wire goggles, which absorb the heat and overheat the eye, and I have seen many eyes injured by using them. In reading or writing, just that amount and quantity of light, whether natural or artificial, should be allowed, which, while it thoroughly illuminates the objects, feels grateful and pleasant to the eyes. This desideratum can never be obtained without due regard to the position of the light. The light cast upon a book, whilst the candle or lamp is in front, is by no means pleasant, and the glare of the flame is very trying to weak eyes. It will be found that if the candle or lamp be placed a little above and back of the reader and slightly to one side, the most pleasant and least injurious effect is produced; for the light when reflected to the eyes is least distressing, and, at the same time, the eyes are perfectly protected from the heat and glare of the flame.

The habit, common with far-sighted persons, of drawing the candle to them, and holding the book they are reading close to it, has reference to the need which then exists for strong light. Eyes, when far-sighted, require more light than younger eyes; and judgment is required to secure this without overdoing it and stimulating the organs too much. It would be well, if in public buildings more attention was paid to the position of the lights. It is very distressing to sit in a gallery, immediately in front of a gas-burner or lamp, for an hour or more; the eyes frequently do not recover from the irritation thus excited for several days. Not only might the evil be easily removed, by employing lights of greater power, properly subdued and placed near the ceiling, but there would be a great advantage gained from the increased purity of the air.

Sudden transition from gloom to strong light should be avoided. The dazzling effect produced when we come suddenly from darkness to light, arises from the pupils having been widely dilated to admit the greatest number of luminous rays whilst in the gloom; as the pupil of the eye requires time to contract, sudden transition from comparative darkness to a bright light compels the eye to admit far more rays than is agreeable, or it is calculated to bear without injury; temporary dazzling and a sensation of pain is excited in consequence. So weak and susceptible do the eyes become, if kept for a long time in darkness, that the ordinary light of day is distressing to them. I have frequently been consulted by patients laboring under this morbid sensibility, sometimes, from having been kept for a long time in a darkened room; at other times, from having injudiciously covered up the eyes with a bandage or shade, in hope of subduing an inflammation. The working classes are fond of binding up their eyes or those of their children, if attacked with any disorder, whether attended with increased sensibility to light or not. It is difficult to convince them of the necessity of taking the bandage off, and, by degrees, to accustom the eyes to the stimulus of the light.

The following are the circumstances which should guide them in their choice of glasses: The glasses should be of the lowest power which will enable them to see objects as distinctly as they may wish, and, at the same time, comfortably; glasses which make objects appear larger than natural, and strain and fatigue the eyes and cause headache, are not adapted to their case. There are two convex glasses used, the double convex being preferred. The lowest power in ordinary use in England has a focus of 48 inches; but in France, very much lower powers are used. M. Sichel commences with a 72-inch, and in some cases with a 96-inch. Mr. Andrew Ross, however, whose experience as an optician is well known, has informed me that, in the course of his business, he has met with but one person who could perceive any sensible difference between those two powers, as far as assistance to sight was concerned.

It is quite possible that, in the early stage of far-sightedness, a 72-inch glass may be sufficient, and if found to be so, it should be by all means preferred to a higher number; but, practically speaking, a 48-inch is that most usually required, because persons in this country seldom seek assistance until the far-sightedness has advanced beyond the aid of a 72-inch glass.

It cannot be too strongly urged upon any one about to use spectacles for the first time, that that power which will enable them to read without much exertion by candlelight, is the only one suitable for them. It is only by candlelight that glasses should be used at first; and as soon as they find that they stand in need of glasses by day, as well as by gaslight, and that the glasses which they use no longer afford them sufficient assistance by gaslight, it will be proper to use the next power for the evening, but for the evening only, and to allow themselves the use of the others only during the day.

The greatest caution, as to increasing the power, should be observed, for persons who change their glasses unnecessarily, increasing the power each time, are exhausting the resources of art, instead of economizing them as much as possible. Optical aid can only be extended to a certain point, and the steps to that point should be as slow and as numerous as possible. By exercising prudent precautions, persons may attain great age, and yet never require the aid of glasses beyond a very moderate power; others, on the contrary, who, from ignorance, frequently increase the power of their glasses, may run through the whole assortment, and leave themselves only the most inconvenient resources to fall back upon, *viz.:* the very highest powers.

The eye should not be permitted to dwell on glaring objects, more particularly on first awakening in the morning; the sun, of course, should not be permitted to shine in the room at that time, and only a moderate quantity of light should be admitted. It is plainly to be seen that, for the same reason, the furniture of the room should be neither altogether of a red nor a white color; indeed, those whose eyes are weak would find considerable advantage in having green for the furniture of their bedchambers. Nature confirms the propriety of the advice given in this rule, for the light of day comes on by slow degrees, and green is the universal color she presents to our eyes.

There is nothing which preserves the sight longer than always using, both in reading and writing, that moderate degree of light which is best suited to the eye; too little strains them, too great a quantity dazzles and confounds them; the eyes are less injured by the want of light than by an excess of it; too little light never does them any harm, unless they are strained by efforts to see objects to which the degree of light is inadequate, but too great a quantity has, by its own power, destroyed the sight. Thus, many have brought on themselves a cataract, by frequently looking at the sun or a fire; others have lost their sight by being brought too suddenly from extreme darkness into the blaze of the sun.

ADVICE ON SPECTACLES.

The discovery of optical instruments may be esteemed among the most noble, as well as among the most useful gifts which the Supreme Artist has bestowed on man. For all-admirable as the eye came out of the hands of Him who made it, yet He has permitted this organ to be more assisted by human contrivançe; and that not only for the uses and comforts of common life, but for the advancement of natural science, whether by giving form and proportion to the minute bodies that were imperceptible to the unassisted sight, or by contracted space, and as by magic art, bringing to view grander objects of the universe, which were rendered invisible by their immense distance from us.

Noble as these inventions are, the discovery of spectacles may still claim the superiority, as being of more universal benefit and more extensive use. They restore and preserve to us one of the most noble and valuable of our senses; they enable the mechanic to continue his labor, and earn a subsistence by the work of his hands, till the extreme of old age; by their aid the scholar peruses his studies and recreates his mind with intellectual pleasures, and thus pass away days and years with delight and satisfaction, which might have been devoured by melancholy or wasted in idleness.

As spectacles are designed to remedy the defects of sight, it is natural to wish that the materials of which they are formed should be as perfect as the eye itself; but vain is the wish, for the materials we use, like everything human, are imperfect. Yet, we may deem ourselves happy, to have in glasses a substance so analogous to the humors of the eye, a substance which gives new eyes, eyes to decrepit age, and enlarges the views of philosophy. The two principal defects are small threads or veins in the glass, and minute specks. The threads are most prejudicial to the purpose of vision, because they refract the rays of light irregularly, and thus distort the object and fatigue the eyes; whereas, the specks only lessen the quantity of light, and that in a very small degree. We are now able to decide upon a very important question, and say how far spectacles may be said to preserve the sight. It is plain they can only be recommended as such to those whose eyes are beginning to fail, and it would be as absurd to advise the use of spectacles to those who feel none of the forecoming inconvenience, as it would for a man in health to use crutches to save his legs. But those who feel these inconveniences should immediately take to spectacles, which, by enabling them to see objects nearer, and by facilitating the union of rays of light on the retina, will support and preserve the sight.

From whatever causes this decay arises, an attentive consideration of the following rules will enable any one to judge for himself when his sight may be assisted or preserved by the use of spectacles:

First. When we are obliged to remove small objects to a considerable distance from the eye, in order to see them distinctly.

Second. If we find it necessary to have more light than formerly, as, for instance, to place the candle between the eyes and the object.

Third. If, on looking at and attentively considering a near object, it becomes confused, and appears to have a kind of mist before it.

Fourth. When the letters of a book run into one another, and hence appear double or treble.

Fifth. If the eyes are so fatigued by a little exercise that we are obliged to shut them from time to time, and relieve them by looking at different objects.

When all of these circumstances concur, or any of them separately take place, it will be necessary to seek assistance from glasses, which will now ease the eyes, and, in some degree, check their tendency to grow flatter; whereas, if they be not assisted in time, the flatness will be considerably increased, and the eyes weakened by the efforts they are compelled to exert.

Blindness, or at least weakness of sight, is often brought on by these unexpected causes. Those who have weak eyes should, therefore, be particularly attentive to such circumstances, since prevention is easy, but the cure may be difficult and sometimes impracticable.

Whatever care, however, be taken, and though every precaution be attended with scrupulous exactness, yet, as we advance in years, the powers of our frame decay, an effect which is, generally, first perceived in the organs of vision.

Age is, however, by no means an absolute criterion, by which we can decide upon the sight, nor will it prove the necessity of wearing spectacles. For, on the other hand, there are many whose sight is possessed, in all its vigor, to an advanced old age; while on the other, it may be impaired in youth by a variety of causes, or be vitiated by internal maladies. Nor is the defect either the same in different persons at the same age, or in the same person at different ages. In some the failure is natural, in others it is acquired.

Though in the choice of spectacles every one must finally determine for himself which are the glasses through which he obtains the most distinct vision, yet some confidence should be placed in the judgment of the optician of whom they are purchased, and some attention paid to his directions.

By trying many spectacles the eye is fatigued, as the pupil varies in size with every different glass, and the eye endeavors to accommodate itself to every change that is produced; hence, the purchaser often fixes upon a pair of spectacles not the best adapted to his sight, but those which seemed to relieve him most while his eyes were in a forced and unnatural state, and, consequently, when he gets home they are returned to their natural state, and he finds the glasses which he has chosen fatiguing and injurious to his sight. The most general, and perhaps the best, rule that can be given to those who are in want of assistance from glasses, in order to so choose their spectacles that they may suit the state of their eyes, is to prefer those which show objects nearest their natural state, neither enlarged nor diminished, the glasses being nearer the eye, and which give a blackness and distinctness to the letters of a book, neither straining the eye nor causing any unnatural exertion of the pupil. For no spectacles can be said to be properly accommodated to the eyes, which do not procure them ease and rest. If they fatigue the eyes, we may safely conclude, either that we have no occasion for them, or that they are ill-made or not adapted to our sight.

It is a certain and very important fact, that long-sightedness may be acquired, for countrymen, sailors, and those who are habituated to look at remote objects are *generally* long-sighted, want spectacles soonest, and use the deepest magnifiers; on the other hand, the far greater part of the short-sighted are to be found amongst students and those artists who are daily conversant with small and near objects, every man becoming expert in that kind of vision which is most useful to him in his particular profession and manner of life. Thus, the miniature painter and engraver see very near objects better than a sailor, but the sailor sees distant objects better than they do; the eyes, in both cases, endeavoring to preserve that configuration to which they are most accustomed.

In the eyes, as well as other parts of the body, the muscles, by constant exercise, are enabled to move with ease and power, but are enfeebled by misuse. The elastic parts, also, if they are kept too long stretched, lose part of their elasticity; while, on the other hand, if they be not duly exercised, they grow stiff and are not easily stretched.

From the consideration of these facts, we may learn, in a great measure, how to preserve our eyes. By habituating them occasionally to near as well as distant objects, we may maintain them longer in their perfect state and be able to postpone the use of spectacles for many years, but we may also infer from the same premises that there is great danger when the eyes have become long-sighted of deferring too long the use of spectacles, or using those which magnify too much, as we may by either method so flatten the eye as to lose entirely the benefits of naked vision. It may not be improper, in this place, to remark that the long-sighted eye is much more liable to be injured by too great a degree of light than those which are short-sighted. Though it is in the general course of nature that this defect should augment with age, yet there are not wanting instances of those who have recovered their sight at an advanced period, and have been able to lay aside their glasses and read and write with pleasure without any artificial assistance.

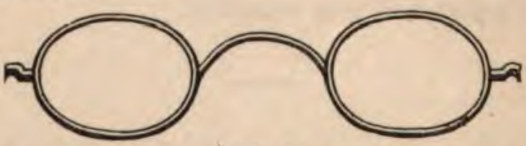
Among many causes which may produce this disease, the most probable is, that it generally arises from a decay of the fat in the bottom of the eye. The pressure in this part ceasing, the eye expands into somewhat of an oval form, and the retina is removed to a due focal length from the crystalline lens.

Increasing years have a tendency to bring on this defect, and earlier among those who have made less use of their eyes in their youth; but whatever care be taken of the sight, the decay of nature cannot be prevented. The humors of the eye will gradually waste and decay, the refractive coats will become flatter, and the other parts of the eye more rigid and less pliable; thus, the latitude of distinct vision will become contracted. It is also highly probable that the retina and optic nerve lose a portion of their sensibility.

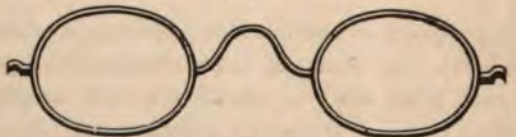
ADVICE ON SPECTACLE FRAMES.

There is one point of considerable importance, which is often disregarded, *viz.:* the fitting of the spectacle frame so that the centre of each glass shall be exactly opposite the pupil of the corresponding eye. A moment's reflection will show how important this is. There are scarcely two persons of precisely the same width between the eyes, and yet, in the majority of cases, this fact is entirely lost sight of in the selection of spectacles. A person finds that when, at an optician's, he looks through a lens of a certain power, it suits him exactly; he sees delightfully with it, and forthwith orders spectacles of that power. He tries them on as soon as he receives them, anticipating with eagerness the comfort they will afford him, instead of which, he finds that he can hardly see at all, or, if he does, his eyes soon feel fatigued. The glasses are right; the error is in the frame. Unless the width between the eyes is such that the centre of each glass is exactly in front of the eye which it is to assist, the rays which pass through the lens will not all enter the pupil, and the spectacles will be comparatively valueless. Care should be taken, then, in every case, to have the bridge made of such a curve and such a width that the position of the lenses, as regards the eyes, should be perfect, both horizontally and vertically.

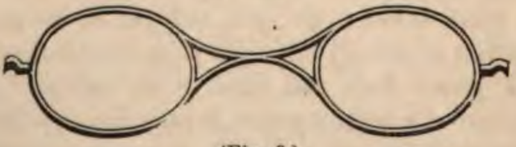
In ordinary myopic spectacles, the average height of the bridge above the axis of the lenses is from one-eighth to three-sixteenths of an inch. Where the arch of the nose is depressed, the bridge is made one-eighth below the centre. The three most remarkable spectacles are represented in the following figures. The first (Fig. 1.), is that commonly used for presbyopic glasses. The second (Fig. 2.), brings the glasses near the eyes. The third (Fig. 3.), is sometimes preferred, as being generally useful:



(Fig. 1.)



(Fig. 2.)



(Fig. 3.)

I have mentioned the curve, as well as the width, for by it the height of the glass is adjusted. Short-sighted persons require the glasses to be nearer the eyes than do far-sighted, and this is to be regulated by a peculiar curvature of the bridge, a curvature in two planes, rising vertically and projecting out at the same time, as represented in (Fig. 2.)

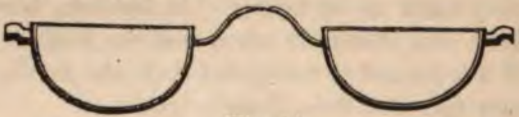
It may be as well to notice here that whenever the frames are well fixed, the two eyes appear to the individual to be looking through the glasses only.

The material best adapted for spectacle frames is blue steel, which combines the advantages of lightness, elasticity, durability, and neatness of appearance. The brilliancy of gold and silver frames is objectionable, as tending to dazzle the eyes, and from this the blue steel frame is free. Some persons prefer tortoise-shell frames, but these have a heavy appearance, and are very liable to be broken. If, however, fancy incline toward them, care should be taken that the front is all black, because if it is framed of variegated shell, the dazzling will be even greater than that from silver or gold.

The front of the frame should be made to project sufficiently beyond the glasses to protect them from friction in drawing them in and out of the cases, or from being scratched when laid flat down. Many persons are very careless as to this, leaving their spectacles lying about, allowing them to become dim with moisture and dirt, and wiping them with the first thing that comes to hand—their coat-tails or pocket-handkerchief; but if they wish to keep their glasses in a good state, they should be sedulous to clean them with wash-leather which has been freed from the yellow ochre used to color it, for this offers less risk of scratching the glasses than does silk or any other material.

One cause of the prevalence of small spectacles is to be found in the supposed interest of some opticians to prevent the use of any other kind. The reasons they allege for so doing would really be laughable, were not the injury thereby done rather too serious to be treated as a joke. Some of these gentlemen object to the large spectacles because, forsooth, they would "cut into too much shell!" others wish to know "what is to become of their old stock;" and others, again, assert that far more small spectacles are sold than ever would be were large ones worn. The shopman of one of them always recommends the small ones, but the master himself wears the large oval ones, because he finds them much more serviceable, and can see better with them. Whether the opticians are right or wrong as to their own interests in this matter, I will not undertake to say, but certainly none of these reasons are likely to have much weight with the party chiefly concerned.

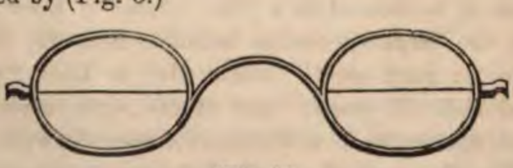
The public portrait painter, and others who require to compare objects at different distances quickly and frequently, often use semicircular lenses, straight at the top, so that by raising the eyes they can see over them. This, however, causes grimaces and fatiguing elevation of the brows. These spectacles are represented in (Fig. 4.)



(Fig. 4.)

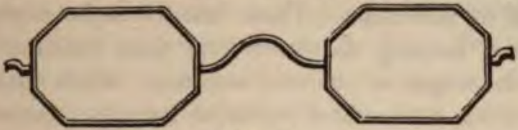
There is one obstacle more dangerous than all—that is, the divided glass. The lenses for divided glasses are cut in halves, and a portion of each mounted in a large circular frame; in this description of spectacles, the two segments of lenses are united as firmly as possible in the medium line, the most convex or reading lens is below, the least convex above, so that by simply dropping the eyes or raising them, the person can see near or distant objects.

These spectacles are objectionable, because the medium line where they are attached together is exactly in front of the pupil of each eye. In reading the rays are on the retina, and the distant glass is on the other side of the retina, and the rays of the reading glass form before they reach the retina, which causes confusion, fatigue, and headache. The divided glass is represented by (Fig. 5.)



(Fig. 5.)

There is another sort of spectacle frame that I object to: that is the octagon shape, which is very small, and the eye collects a pencil of rays from each corner, which creates confusion and dazzling of objects. This is represented by (Fig. 6.)



(Fig. 6.)

I recommend the large oval steel spectacles, which give the eye rest and ease, and with which a person can read longer and with less fatigue. Blue steel acts as an absorbent to the eye. I have made it my study, for forty years, to ascertain what is good for and what is an injury to the eyes.

ADVICE ON DOUBLE GLASSES.

We have represented the four-glass spectacles, opaque or colored glass sides being attached to the lens-holder of the spectacle, thus enabling one to exclude all side rays, as well as those directly in front of the eye. They were formerly made with convex or concave glasses fitted in the front of the frame, and by simply shutting down the colored plane glass sides, a tinted lens was at once formed. I highly recommend them for far and near glasses, mounted in light steel frames, four-glass spectacles to obtain a double-focus spectacle; thus: in the front frame is placed the lens which best suits for distance, and in the side frame a lens of such a power as, when combined with the front lens, would suit for reading, etc. By this method, when spectacles for distant vision are desired, it only becomes necessary to remove the side glasses from the front ones.

When properly suited, the rays of light are brought to a point upon the retina, and by letting the side glasses down, they also are brought to a point for reading. They do not cause confusion, headache, or dazzling.

DUST SPECTACLES, GOGGLES.

Wire-work in spectacle frames was at one time used as such, and called by this name. These dust spectacles have the disadvantage of keeping the eye behind them continually enveloped in the vapor of its own moisture, which cannot fully escape. Thus, the irritated condition is rather increased than diminished. The principal reason for their disuse lies, however, in the impairment of distinct vision, which compels the patient to strain his eyes severely in order to see surrounding objects distinctly. By the wire-work considerable objective light is kept away from the eye, and the frame of the dust spectacles places the translucent gauze in an unfavorable angle to the outer world, thus limiting the visual field; moreover, the manifold diffraction which the transmitted light undergoes on the wire-gauze comes into consideration. Besides, when these spectacles are worn in an atmosphere loaded with dust, the meshes of the gauze become filled, and then their defects are increased. Ordinary glass spectacles of circular shape, about an inch in diameter, are to be preferred to the dust goggles above described. Of course they protect the eye less; but where the dust is so abundant that sufficient protection is not afforded by the ordinary glass spectacles, or where a small amount of dust upon the eye proves injurious, the surgeon does well to prohibit the patient from being thus exposed.

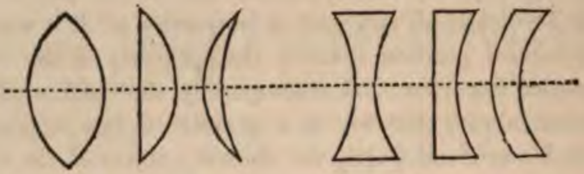
EYE PROTECTORS.

I now proceed to speak of those contrivances by which assistance may be rendered to eyes where the vision is impaired from accident, operation, or imperfection in form or direction. For perfect vision, it is essential that the rays of light pass through the centre of the crystalline lens, as then only is a true and correct image depicted on the retina; this cannot take place if the pupil be displaced, and just in proportion as it is removed from its natural position towards the periphery of the iris is the refraction imperfect, and, consequently, the vision confused. This almost always follows, in a greater or less degree, the operation for artificial pupil; for the very object of the operation is to give sight by making a new opening in the iris, in cases where the natural pupil has been closed or destroyed; and the instances are few in which this can be placed exactly in the centre. Again, as the proceeding in question consists in dividing or cutting away a portion of the iris, the new pupil is devoid of that beautiful arrangement of fibres by which contraction or expansion is provided for; it is, therefore, motionless under all conditions of light. The following are the results of many experiments made by me, for the relief of such cases:

If the aperture be central, but too large, it resembles mydriasis, or permanent dilation of the pupil, and may be thus obviated: A thin plate of Japanned black steel, slightly concave on the inner side, should be fitted into a spectacle frame; in the centre there should be a small hole, the actual size of which must be determined by experiment in each case, in order that its dimensions may be precisely those which afford the best vision. This, worn before the eye, imitates a pupil in a state of contraction, and, by limiting the light entering the eye, materially assists vision. It may, however, be more convenient to have a slit instead of a simple aperture, to admit of extended lateral vision. (Fig. 9.) represents both forms.

THE VARIETY OF LENSES.

In order that the action of spectacles may be clearly understood, I will, before entering upon the subject, explain the effects of the different kinds of lenses upon the rays of light. There are six varieties of common lenses:



1. The double-convex lens is bounded by two convex spherical surfaces, each of whose centres is in the axis of the lens only on the sides opposite to their surfaces.

2. The plano-convex lens has one side convex, the other plane.

3. The meniscus has one surface convex, the other concave, and the surfaces meet if continued.

4. The double-concave is formed by two concave spherical surfaces, whose centres are on the same side of the lens as their surfaces.

5. The plano-concave has one surface plane, the other concave.

6. Concavo-convex has one surface concave, the opposite convex, but these do not meet if continued.

ADVICE ON SPECTACLE LENSES.

When a convex lens is properly worked, it should exactly represent two segments of the sphere, or of two different spheres, with their plane surfaces in opposition, and placed in the same axis. Then only does it give a clear and distinct image of the object submitted to its action. If the working of the lens be not accurate, every variation from the true curvature will interfere with refraction and the perfect definition of the image, points of much importance in lenses used to assist vision.

The same remarks apply to concave lenses.

In China, rock crystal is used throughout the empire for lenses. They are ground with the powder of corundum, and when mounted, form most original spectacles, being circular and of immense size, and retained in position by silken cords with weights attached, which are slung over the ears.

THE MANUFACTURE OF LENSES.

I shall, in the first place, describe the mode in which spectacles are made; after that, proceed to their application.

The glass principally employed for spectacles and optical lenses is plate glass of the purest quality; it requires the nicest adjustment as to the proportion of its ingredients—silicate of soda, and lime; the presence of too much alkali attracts humidity from the atmosphere, causing the glass to become dull, or, in the language of the opticians, to "sweat."

The French plate glass is, in point of color, superior to the British, but has the disadvantages of softness, fraxility, and a tendency to become dull; therefore, although it is preferred by some opticians, the glass known as "British Plate" is, on the whole, the best.

The mode of making spectacle glasses and lenses generally, is as follows:

A piece of glass, of a thickness proportionate to the convexity or concavity of the intended lens, is cut into small squares with the diamond; after these small squares have had their corners snapped off they are fixed with cement to a metal tool, the concavity or convexity of which corresponds to the curve which they are intended to receive. They are then worked by hand or machinery on the smoothing tool, which latter must be perfectly true, of a radius in accordance with the focal lengths of the intended lenses. They are worked with a peculiar kind of eccentric motion, which is found to give equal friction to all parts of the surface. After the lenses have been thus gradually rounded into shape, and smoothed by emery powder of different degrees of fineness, prepared for this purpose, they are subsequently polished with oxide of tin, commonly called putty, which is laid on a polisher made of felt and cement, and formed to the curve of the smoothing tool. When one side of the lens is completed, the other side is subjected to a like process; and when both sides are perfectly polished, all that is required is to cut and grind the edge to fit the spectacle frames.

There is a common prejudice in favor of pebbles, and they certainly possess two advantageous qualities: extreme hardness, rendering it difficult to scratch or break them; and clearness, never becoming dull from moisture. They have, however, the disadvantage of being expensive, partly on account of the additional labor in making them, partly from the number of imperfect ones found in their manufacture, whereby the price of good spectacles is enhanced.

The earliest mention of artificial aid to sight occurs in the writings of Roger Bacon, who speaks of an "instrument useful to old men, and to those who have weak eyes, for they may see the smallest letters sufficiently magnified."

Mons. Spoon, in his "Recherches Curieuses," fixes the date of the invention of spectacles between A.D. 1280 and 1311. This seems to be satisfactorily made out, for a number of references to them is made in the writings of persons in the early part of the fourteenth century.

ADVICE ON COLORED GLASSES.

From time immemorial, the Chinese have used, for checking the glare of the sun, a substance called *cha-she*, or tea-stone, from the resemblance of its transparent hue to a weak infusion of black tea; it is probably smoky quartz or silex, allied to the cairngorm of Scotland. In selecting this color, they have shown wisdom; for although glasses of all tinges of blue and green are to be found in the shops of opticians, the hue is called neutral tint, similar to that used by the Chinese. It does the least injury to the eyes, and for the following reasons:

When the eye, after having been strongly impressed with any particular species of colored light, is directed to a sheet of white paper, it will not be capable of determining for some time that the paper is white, neither will it attribute to the paper the color with which the eye was impressed, but a different color, which is called its accidental or complimentary color. The following is a table of the colors, and of those which are complimentary to them:

Color.	Complimentary Color.
Red,	Bluish-green.
Orange,	Blue.
Yellow,	Indigo.
Green,	Violet-reddish.
Blue,	Orange-red.
Indigo,	Orange-yellow.
Violet,	Yellow-green.
Black,	White.
White,	Black.

Thus, when the eye has been for some time looking through a blue glass, the retina becomes less sensible to light; consequently, the moment the blue glass ceases to be used, the retina being less sensible to the blue rays which form part of the white light flowing from the paper, the paper will appear of that color which arises from the combination of all the rays of the white light which it reflects, with the exception of the blue, that is, it will appear orange-red; in like manner, green will excite the violet-red spectrum. As colored glasses are almost always made use of to screen the eyes in cases where there is undue sensibility of the retina, anything which unnecessarily blunts the sensitiveness of that membrane (such as a particular color), though temporarily, should be avoided.

It is on this account that the neutral tint glasses are to be preferred. Being, as the name implies, of no definite color, they screen the eyes from all colors alike, and produce in the sunshine the effects of a cloudy day, which is exceedingly grateful to weak and irritable eyes.

There are two descriptions of neutral tints: a bluish-gray and a brownish-gray, and the several shades of each. I give the preference to the brownish-gray. The chief risk in selecting glasses of this description is that of choosing too dark a shade.

Neutral tinted glasses are divisible into two distinct classes of cases: those in which the retina is irritable and will not bear the excitement of light, and those cases of incipient cataract in which they assist vision simply by modifying the light and causing dilatation of the pupil.

In the first class of patients, the use of too dark a shade of glass is injurious by rendering the eyes still more susceptible to light; producing, in fact, the same effect as shutting up the patient in a darkened room. The shade selected should be that which is grateful to the eye, but never darker than necessary; and if dark glasses have been in use, it will be proper to discontinue them, and to gradually accustom the eyes to the stimulus of ordinary light, by reducing the tint in successive changes.

It is advisable that persons habitually using tinted glasses should close the eyes once or twice, for a second, on taking them off, thus rendering the contrast between the shade and the light less marked.

It must be borne in mind, with reference to the darker shades of neutral tint, that they are liable to heat the eyes; a black substance absorbs all the calorific as well as the luminous rays, and, therefore, sooner becomes warm and rises to a higher temperature than substances of other colors. The nearer, then, the neutral glass approaches to black, the more it will heat the eye.

I may refer, *en passant*, to an experiment of my own, demonstrating the relative heating properties of black and white. I covered two patches of snow with cloths, the one black, the other white. The snow beneath the black cloth very soon melted, whilst little or no effect was produced on that beneath the white. This is a fact of practical value, for the tunics of a sensitive or morbidly irritable eye soon feel the discomfort arising from this property of dark glass, which literally, as well as figuratively, feels hot to the eye it covers.

It occasionally happens that myopic persons require the aid of neutral-tinted glasses. There are two ways of supplying the want: either by grinding the lens of the tinted glass itself, or by cementing an ordinary plano-concave lens on a tinted plane glass. The last mode is much used by Messrs. Carpenter and Westley, who inform me that the low numbers, up to about No. 6, may be cemented with the utmost nicety; but that when a higher number is required, it is preferable to have a tinted side-piece let down when required, as the inequality of the refractions, if cemented, would interfere with the perfection of the spectacles.

The desire to conceal from the world any imperfection which wounds our self-love, is inherent in the human heart, and leads to all sorts of artifices on the part of those who, by natural conformation, advancing years, or other causes, suffer from an imperfection in their vision.

CYLINDRICAL LENSES.

Conceive a lens ground with two cylindrical surfaces of equal radius, one concave and the other convex, with their axes crossed at right angles. Call such a lens an astigmatic lens; let the reciprocal of a focal length in one of the principal planes be called its power; and a line parallel to the axis of the convex surfaces, its astigmatic axis. Then, if two thin astigmatic lenses be combined, with their axes inclined at any angle, they will be equivalent to a third astigmatic lens, determined by the following construction:

From any point draw two straight lines, representing in magnitude the powers of the respective lens, and inclined to a fixed line drawn arbitrarily in a direction perpendicular to the axis of vision at angles equal to twice the inclinations of their astigmatic axes, and complete the parallelogram.

Then the two lenses will be equivalent to a single astigmatic lens, represented by the diagonal of the parallelogram, in the same way in which the single lenses are represented by the sides.

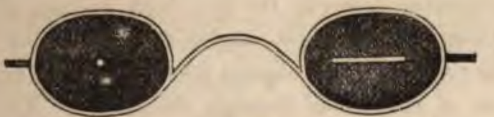
A plano-cylindrical or sphero-cylindrical lens is equivalent to a common lens, the power of which is equal to the semi sum of the reciprocals of the focal lengths in the two principal planes, combined with an astigmatic lens, the power of which is equal to their semi difference. If two plano-cylindrical lenses of equal radius, one concave and the other convex, be fixed, one in the lid and the other in the body of a small round wooden box, with a hole in the top and bottom, so as to be as nearly as possible in contrast, the lenses will neutralize each other when the axes of the surfaces are parallel; and by merely turning the lid around, an astigmatic lens may be formed, of a form varying continuously from zero to twice the astigmatic power of either lens. When a person who has the defect in question has turned the lid till the power suits his eye, an extremely simple numerable calculation, the data of which are furnished by the chord of double the angle through which the lid has been turned, enables him to calculate the curvature of the cylindrical surface of a lens for a pair of spectacles which will correct the defect in his eye.

A curious case is related in the *Annales de Oculistique*, of an anomaly of vision, probably the consequences of a defect in the form of the cornea, such as that under consideration:

Mrs. Holstrid, of Chicago, was presbyopic for horizontal, and myopic for ventricular. This she remedied by wearing spectacles, the glasses of which were cylindric bi-convexes, with rectangular, horizontal, and similar axes. These glasses obviated the presbyopic relative to the horizontal lines, and they were confined with sphero bi-concave lenses to get rid of the myopia for vertical lines. Each of the glasses were made movable, for the facility of cleaning.

The following means are recommended, to ascertain if an eye has the defect now described: The person should attentively contemplate, for some time and with attention, a cross + three or four lines in size, made of fine wire, and fixed in a frame; if affected, he will see the horizontal lines differ in thickness and blackness of tint from the vertical.

In astigmatic eyes, vision is distributed in such a manner that the patient finds it difficult to describe his symptoms, but on testing his sight, it is evident that it had not the normal acuteness, and that it is improved in a slight degree only by ordinary concave or convex lenses. On desiring him to look at test-lines of equal length and breadth placed parallel to each other, some of them in a vertical and some in a horizontal position, he finds that he sees one set of the lines more clearly than the other. A square appears elongated to a parallelogram, and, at the same time, less sharply defined in the direction of its length. A small round hole in a screen, behind which is a bright light, seems oval or even linear. If large letters are looked at at twenty feet distance, some of the lines will be clearly seen, while those at right angles with the first will appear blurred, or of double contours. On looking through a spectacle with a small aperture or narrow slit, held in a proper direction, the confusion disappears. (Fig. 9.) represents the spectacles:



(Fig. 9.)

This forms, perhaps, the readiest method to ascertain the direction of astigmatism. Its degree is ascertained by placing convex or concave glasses before the slit till we find with what number vision is clearest.

Great care is required in setting cylindrical glasses; as even a slight want of correspondence between the meridian of deviation and the proper relative position of the glass almost annuls its effect. The glass is to be turned before the eye till the vision becomes clearest, and at this point should be marked by the optician, so that it may be set in the frame in precisely the same position. The frame should be well fitted to the wearer, as even a very slight obliquity or tilting of the glasses lessens their beneficial effect. For this reason, spectacles are, usually, to be preferred to eye-glasses, as they keep more steadily their proper position. The cylindrical glasses are required for all purposes; both near and distant objects seeming blurred and distorted without their aid.

PERISCOPIC GLASSES.

There are three varieties of lenses in common use for spectacles: the double-concave for short-sighted persons; the double-convex for long or aged sight; and a third description, invented and patented by Dr. Woolaston, to which he applied the term periscopic, so called from the facility they were supposed to afford for looking around at various objects without turning the head, and so giving a wide field for vision. They were also intended to obviate the defects in common lenses, in which no object appears distinct through them, except such as are seen through the centre. Dr. Woolaston conceived that by making each side concave towards the eye, each portion of its surface might be nearly at its right angles to the axis of vision, and would thus render lateral objects distinct without impairing the distinctness of those seen through the centre. This effect, for far-sighted persons, he accomplished by means of the meniscus, with the concave surface next the eye; and for short-sighted persons, he adopted the concavo-convex.

There can be no doubt that the advantage of a wide field is gained, in proportion as the second surface of the lens approaches to the form of the curvature of the cornea; but this is scarcely necessary, as we generally turn the head to look at an object, instead of glancing at it obliquely.

Periscopic glasses would be applicable, but they do not render vision so distinct as ordinary lenses, and they increase (although in a very slight degree) the aberration both of color and figure; therefore, the double-concave or convex lenses are to be preferred to the periscopic.

CATARACT GLASSES.

The object aimed at in operation for cataract is, either to abstract the opaque crystalline lens from the eye, to cause its absorption, or to displace it, so as to give a free passage to light. As the image formed on the retina depends upon the refraction produced by means of the crystalline lens, and on its power of self-adjustment to objects at different distances, the consequences of its loss, usually, are indistinctness of vision, and loss of power of accommodation to distance. If, prior to the formation of cataract, the eye was perfect (not merely as to its power to define objects at a given distance, but as to the power of adjustment to distance also), there is, after the operation, an incapability of discerning near objects, as the eye no longer has the power to accommodate itself to the necessary focus. To remedy these inconveniences, double-convex glasses are employed; and it is necessary to have two pairs, of different focal lengths: one for looking at distant objects, the other for reading and writing. The following are the numbers of my test-glasses: For reading, Nos. 2, 2¼, 2½, 3; for distant objects, Nos. 3½, 4, 4½, 5. Opticians, however, have a greater variety, to suit exceptional cases.*

Where only one eye has been operated on, or where the operation has failed in one, it is convenient to have a frame with a double bridge, as in (Fig. 3.), so that it can be worn with either side up; one circle may be fitted with a reading lens, the other with a lens for distant vision; and by simply turning the frame either way, it will be placed before the useful eye.

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* The lenses used by divers, if made of crown glass and equi-convex, must have the curvatures of both surfaces equal to that of the cornea; for, in order that the refraction of such a lens may be equal to that of the cornea which it is intended to supply, the focal length of the lens in water must be equal to that of the cornea in air. It must be borne in mind that when the eye is immersed in water, the first and most considerable of its refraction is lost, for the refractive power of the aqueous humor is very nearly that of water, and so, the cornea being bounded by surfaces which are nearly parallel, the rays will pass from water into the aqueous humor without undergoing refraction. Thus, a powerful convex lens is required to afford distinct vision.

If the sight of one eye be so imperfect that it interferes with the vision of the other, a dark neutral-tinted glass or a thin opaque plate may be advantageously fitted in the circle intended for that eye. There is considerable variety in the amount of assistance required, but glasses of four and a-half inches focus ordinarily serve for viewing distant objects, and two and a-half inches focus for reading or writing. In the selection of glasses, those of the longest focus that will answer the purpose are to be preferred. The glasses recommended by my lamented friends, Mr. Tyrrell and Mr. Dalrymple, were of three-quarters of an inch diameter, and mounted in a broad tortoise-shell rim, to diminish the weight of the spectacles and limit the quantity of light admitted into the eye.

A cataract glass, when placed in front of the eyes, gives perfect vision of objects at the distance at which they could be distinctly seen before the change in the lens commenced. If the focus be too long, the patient will find it necessary, after a time, to remove the glasses two or three inches from the eyes, in order to see distinctly, and in such a case, glasses of a shorter focus must be procured. If the focus be too short, the patient will mistake the distance of objects from him, as they will appear nearer than they really are, and the hand, in the effort to grasp them will fall short of them. For some time after operation for cataract, the patient (especially if young) should endeavor to do as much as possible without glasses; for although the adjusting power inherent in the eye is destroyed by the operation, nature will, if compelled, make great efforts to provide a substitute. Glasses, then, should not, under any circumstances, be permitted for a considerable time after the operation, nor, indeed, so long as vision continues to improve without them. If they be used too early, and the glasses are too powerful, the eyes may become enfeebled and require more and more assistance, so that, after a time, no lenses will be found of sufficient power.

If the individual will wait until the eye has completely recovered, and will habituate the organ as much as possible to its altered state, he will then be in a condition to select glasses of a proper strength, and these, if used sparingly, will probably serve him all his life.

READING GLASSES.

Thus it is, that some persons prefer to use an eye-glass, in lieu of spectacles. Reading-glasses and hand-glasses are adapted for occasional use, as the elastic mounting enables them to be opened and brought into position at once; but they are objectionable, from not being firmly fixed in front of the eyes.

The motion of the head not being in accordance with that of the hand which holds the glasses, has the effect of trying the eyes exceedingly, in their constant and ineffectual endeavor to adjust themselves to the position of the glasses, inducing considerable fatigue of the eyes, and rendering necessary an earlier resort to glasses of a higher power than would have been required had proper spectacles been adapted from the commencement. The eye-glasses which are fixed by a spring to the nose, have the disadvantage of the centres of the glasses never being in front of the pupils, and though serviceable for prompt and occasional use, are objectionable for reading, writing, or any continued occupation.

But a single eye-glass is more injurious still, and many young men who, from shortness of sight, have thought proper to use a quizzing-glass (as it is frequently termed), have had reason to repent it to the end of their lives. I am acquainted with a gentleman, the sight of whose right eye has been seriously impaired from his having in early life constantly used one of these eye-glasses; and numerous other instances have come to my knowledge. The consequences to perfect vision are serious, for as one eye is made to do more work than the other, an alteration in their relative strength takes place; the result is, that, sooner or later, when a person resorts to spectacles, he finds that the lens which suits one eye will not at all suffice for the other. Watchmakers and other artists who work with a magnifier, are very subject to this imperfection of vision, and generally find that they can see better with one eye than the other.

If, instead of always applying the magnifying-glass to one eye, they were to use the other eye in turn, a habit which might be easily acquired in early life, though with difficulty afterwards, they would preserve the power of their eyes more equally, and the perfection of vision longer; for, by using the eyes alternately, rest and an opportunity of recovering from the fatigue produced by the exertion of looking through the magnifier would be afforded to each.

In like manner, those who indulge in microscopical or astronomical pursuits, should learn to use either eye indifferently, instead of always trusting to one; although we almost instinctively apply the right eye to a telescope or microscope. Many medical men have informed me that from constantly looking through microscopes, etc., with their right eyes, the focus of that eye has been rendered so much longer than that of the left eye, that while the left eye is suited by a glass perfectly plane, the right requires a lens of 30 inches focal length.

GLASSES FOR AMAUROSIS.

The first person who appears to have systematically used magnifying glasses as a means of restoring sight to amaurotic eyes, was a German charlatan, named Schlesinger, who visited Brussels in 1838, professing to cure weak sight, strabismus, cataract, amaurosis, etc., with glasses of his own invention. This attracted the attention of Dr. Cunier, who, after some pains, discovered the means employed by this man, which were neither more nor less than practising the eyes daily with plano-convex glasses, beginning with very high powers and reducing them, first, by quarters of an inch, then, by halves, and last, by one and two inches, till the lowest powers were reached. Dr. Cunier put this in practice, with happy effect. The following is a description of the treatment, as applied to a particular case: Madame la Baronne de R., 40 years of age, perceived that the sight of her left eye failed, without particular cause, and after eight years, during which treatment was unsuccessfully employed, she could with difficulty discern the large letters forming the heading of newspapers; neither could she distinguish the features nor the form of a person one or two feet distant. On examination, the pupils were seen to be moderately contracted, but on covering the right eye, that of the left dilated widely, and did not reäct under the strongest light. The greenish-grey tinge often seen in long-standing amaurosis was visible deep in the eye. After a variety of unsuccessful treatment, Dr. Cunier determined to try what could be done with glasses. With No. 3 plano-convex, Madame R. recognized, though with difficulty, letters of the largest type. After some minutes' exercise, there was confusion of sight, the eye watered, and a sort of veil, thickening more and more, grey, then black, shrouded the letters; frontal pain also came on, and it was necessary to discontinue the exercise; but, on the application of cold water to the forehead and eyes, these symptoms soon disappeared. On the second day, the reading was with No. 3½; and was practised seven times, from eight to ten minutes each time, before fatigue came on. The interval of an hour took place between each exercise. The letters were easily recognized that evening at the distance of three inches. The following is a summary of the exercises:

No. 3,	one day,	5	exercises	of from	2 to 4	minutes.
" 3½,	"	7	"	"	8 to 10	"
" 4,	half day,	3	"	"	10 to 15	"
" 4½,	"	5	"	"	10 to 15	"
" 5½,	one day,	6	"	"	10 to 16	"
" 6,	2 days,	13	"	"	10 to 15	"
" 6½,	one day,	6	"	"	10 to 15	"
" 7,	"	6	"	"	10 to 15	"
" 8,	"	7	"	"	10 to 15	"

The exercise was continued on the evening of the 10th day during 22 minutes. Madame de R. saw the hour by the clock at 75 centimetres, and recognized persons at double that distance. The glasses, when used, were:

11th day of treatment,	No. 11
12th " "	" 12
13th " "	" 14
14th " "	" 16
15th " "	" 18
16th " "	" 22
17th " "	" 24

Each of the exercises requiring from 20 to 40 minutes. Small text was read on the seventeenth day without difficulty. Madame R. did not cease to use No. 24 until the expiration of two months, during which time aloetic medicines were taken. Ultimately, the sight of the left eye became as good as that of the right for reading, at from 12 to 14 inches, and for seeing large objects at from 10 to 14 metres.

M. Fronmüller has already reported favorably of the use of graduated glasses, and states that, by their aid, he has cured many cases of amblyopia and mydriasis. He thus explains their action: The retina is irritated by the employment of glasses, and especially by the increase of light thrown upon it, and by the direct excitement of its function. This irritation communicated to the brain and reflected from it through the oculo-motor nerve, neutralizes the action of the sympathetic nerve, which (he imagines) determines the dilatation of the pupil, and so the disorder is overcome. This explanation will, it is feared, not be satisfactory to physiologists in general, but there can be no doubt, whatever may be the modus operandi, that in many cases of amblyopia, either from disuse of the eye, or from deficient energy in the retina, the careful and judicious employment of glasses is attended with excellent effect. The plan which seems last, is to commence with such power as enables the person to see large type; to rouse, but not fatigue, the retina by repeated exercises, short in duration at first, but gradually increased in length; and to reduce the power of the glasses by very short steps, so that each glass, in succession, may establish and improve upon the effect produced by the former. Simple though the plan is, it requires caution, should not be adopted without consideration, and the practice should be carried on under the superintendence of a competent authority. In the first instance, the largest type may be required, but its size should be diminished in proportion as the dormant sensibility of the retina is aroused. The exercises should be performed in a good light; and after each, the eye should be bathed with cold water, if practicable, by means of an eye-fountain.

In cases of strabismus, where the sight is imperfect from disuse, the practice with the glasses may be concurrent with that recommended to strengthen and equalize the muscles; and in cases of amaurotic insensibility, treatment calculated to remove any functional derangement which may tend to keep up the disorder of the sight, ought to be carefully employed.

ASTHENOPIA.

There is a condition of the organs of vision, in which they are unable to sustain continued exercise upon near objects, although the patient, on first viewing such objects, generally sees them distinctly and clearly. But after a time, varying in different subjects from a few minutes to an hour, a sensation of constraint affects the eyes of some, whilst others complain of a feeling of tension or of weight, with heat, running of water, and double vision, accompanied with a feeling of fatigue in the eyes and headache, confusion and obscurity having spread over the objects which had been previously clear and distinct. These persons can employ their sight for any length of time in viewing distant objects, and present no external appearance of disease of the eye. This affection of the eye is called "asthenopia," or weak-sightedness, and is often mistaken by both physicians and patients for "amaurosis," and treated accordingly; but there is no necessary connection between the two diseases, nor does the one lead to the other.

Asthenopia generally affects the two eyes pretty equally. If only one eye is affected, and the other good, the disease is apt to pass undetected. Asthenopia rarely commences in those who have reached the middle period of life, but almost exclusively takes its origin in childhood or youth. The habit of body of asthenopic patients is generally delicate, for we rarely, if ever, meet with the disease in robust or plethoric subjects. Females are as frequently the subjects of this disease as males.

There are certain diseases of the eye, with which asthenopia is very apt to be confounded, such as photobia, or dread of light; myopia, or short-sightedness; presbyopia, or long-sightedness; night or day blindness; amblyopia; and incomplete amaurosis. On the other hand, it is by no means uncommon to find asthenopia complicated, either with some other disease of the eye or with some general disorder of the nervous or of the circulating system. Asthenopia is often attended by considerable depression of the powers of the mind as well as those of the body, and the disease becomes seriously aggravated by the mental apprehension of the patient. In order to allay these gloomy forebodings, a careful and thorough examination should be made, so as to become satisfied whether there is any disease complicated with the asthenopia that is likely to destroy or seriously impair the vision. If there is not, assure the patient, in the most confident way possible, that he need not have any apprehensions about being blind; that, in fact, he could not become blind from the asthenopia if he were to try. A patient thus relieved of the terrible apprehension of becoming blind almost invariably improves.

The cause or causes of asthenopia are somewhat wrapped in obscurity. In many cases, it appears to be an idiopathic disease, resulting entirely from over-exertion of the sight; working by artificial light, as in night-work of all kinds, and especially in night-study; want of sleep is sometimes the chief agent in producing the disease; prolonged investigations with the microscope, is sometimes the cause of asthenopia; undue exercise of the sight, while a person is convalescing from some general and acute disease; what may be called the fashionable and hothouse education of modern times, is a fruitful source of this disease; the ophthalmia of childhood or of youth may give rise to it, particularly scrofulous inflammation of the eyes; injuries of the eye, and, still more readily, injuries of the branches of the fifth nerve around the orbit, are apt to give rise to asthenopia; asthenopia is often traceable to affections of the brain; the teething of children, any malignant disease of the body, excessive venery, masturbation, spermatorrhœa, congenital imperfection in the organs of vision, a bent position of the body during work, constipation, dyspepsia, agitation, grief, sudden fright, and the use of narcotics, such as alcohol, opium, or tobacco, which tend to blind all our sensitive and motive powers; in fact, debilitating influences of every kind, are apt to aggravate, if not to induce, asthenopia.

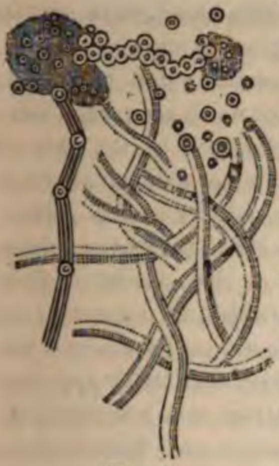
Different definitions are given of this disease: McKenzie calls it "incapability of sustaining the eye in adjustment of near objects;" Lawrence says, "an affection of the retina from excessive employment, commonly called weakness of sight;" and Stellwag defines it, "first, the inability to keep the dioptric system or the visual lines, for a long period, directed to near objects; and, secondly, in close pathological relation to this condition, hyperæsthesia, or exalted sensibility of the retina and ciliary nerves." This definition of Stellwag's is, undoubtedly, the best of the three; but it does not fully define the disease called asthenopia, for there are cases of refractive errors and muscular disturbances not properly of the ciliary muscle, as well as cases in which neuralgic symptoms predominate, which cannot be included in this definition.

Success in the treatment of this disease depends, to a very great extent, upon its cause; if it has originated from disease of the brain, from injury to a branch of the fifth nerve, or from one of the ophthalmiæ, the prognosis would be somewhat unfavorable. If the disease is connected with plethora or local congestion, the prognosis is better; but, if the patient is much debilitated or of a scrofulous constitution, it is very unfavorable. In some cases, it is our duty to declare the disease incurable, and give a reason for this opinion. There are, however, a great many cases of asthenopia which are amenable to treatment, and this treatment will depend, to a great extent, upon the cause of the disease and the constitutional strength or infirmity of the patient. As a general principle, the patient must endeavor to desist from everything which has a tendency to weaken the nervous system or exhaust the organs of vision. Luxury and indolence should be avoided, and, instead, should be substituted early rising, a hard bed, plain and wholesome food, abstinence from the use of alcohol and tobacco and other bad practices, with plenty of exercise in the open air of the country. The application of medicines, either locally or generally, must depend entirely upon the judgment of the physician, who will be guided by the nature of the case, its cause and present symptoms, and by the constitution and present condition of the patient.

Certain cases of asthenopia can be cured by the use of convex glasses, a strong proof that the seat of the disease must be, in part, the apparatus of accommodation, for the employment of such glasses relieves the eye almost as completely as it does that of presbyopia. When the patient has procured his glasses, which he should never do without the advice of a good oculist or optician, let him use them in the way and manner prescribed for him by his adviser, and he will find a marked improvement in a short time, which will inspire him with hope and zeal for further and permanent benefit. I, myself, during a practice of 40 years as an oculist and optician, have cured hundreds of cases by the aid of convex glasses, conjoined with medical treatment, such as stimulating embrocations, etc., etc., etc.

MUSCÆ VOLITANTES.

Muscæ volitantes appear to the patient who has made no particular examination of them, under the form of blackish motes, or of a thin film, like the wing of a fly, or of semi-transparent grey threads, like spider's web; but if viewed attentively against the clear sky, a white wall, or the like, they are recognized to



(Fig. 10.)

be made up of appearances such as the following:

1st. A convoluted string of beads, or a convoluted transparent tube, containing in its interior a row of beads smaller than its diameter, except here and there where one larger than the rest is seen occupying its whole diameter, the end of the string or tube sometimes presenting a dark, knobbed extremity as if formed by an aggregation of the beads composing the string, or contained within the tube.

2d. Insulated beads, some of which, and these the more frequent, have a well-defined outline; others, and these rarer, have an indistinct outline; and,

3d. A parcel of flexuous, round, watery-looking or spun-glass-like filaments, with dark contours, often divided inferiorly into truncated branches.

These different appearances may be seen altogether, the beaded appearance on one side of the parcel of watery-looking filaments, and interspersed, here and there, the insulated beads, one or two of the well-defined of which often appearing as if attached to the outside of the beaded tubes; or some one of the appearances may be seen principally or exclusively. According as the distance of the object against which the muscæ volitantes are viewed is greater or less, they appear larger and fainter, or smaller and more distinct. Vision is not affected by floating muscæ. Between the several portions of the muscæ and by the side of them, the eye still sees everything with perfect distinctness. Even the portions of the retina, over which the shadows which cause the appearance of the muscæ fall, are found by the patient, when the corpuscles ascend out of the field of vision, to be perfectly sensible.

Muscæ volitantes are often detected suddenly, and thus supposed to have just occurred. They are most observed when the patient looks at the clear sky, a thin cloud, snow on the ground, a white wall, or the like. They are not much, if at all, noticed under the opposite circumstances of a dull night, and looking at a dark object. They are not much seen when near objects are looked at. They are rarely seen in the axis of vision, but generally seen to one or the other side, or above or below. The patient thus seeing them only by a side glance, finds it difficult to fix them in order to study their appearance. They move as the eyes move, upwards or downwards, or from side to side; but besides this motion, which, as dependent on that of the eye, is merely apparent, the muscæ have a real motion of their own, and still more extensive than their apparent motion. Thus, if from looking before him in a horizontal direction, the patient suddenly raises his eyes and fixes them on some object above the horizon, he observes that the muscæ fly upwards, considerably above that degree of elevation, and even beyond the field of view, and then come sailing down before him, till they disappear below. Besides the motion of ascent and descent, the muscæ volitantes under consideration present lateral movements, although less marked, as well as changes in the relative positions of their several parts.

Nature of Floating Muscæ.—Hitherto, a very common opinion as to the nature of floating muscæ has been, that they are subjective sensations, depending on some intrinsic change of state of the optic nervous apparatus, thus confounding them with mixed muscæ; but that they are truly objective sensations, occasioned by the presence of particles in the interior of the eye, but extrinsic, and in front of the retina, throwing their diffracted shadows on the retina, admits of mathematical demonstration. But, without entering minutely into the matter, the matter may be easily demonstrated thus: Hold between a convex lens and the white surface on which the image of the light falls, some small object, as a pin. When this is near the lens, its shadow is not seen on the white ground, but when it is brought nearer and nearer the white surface, its shadow appears more and more distinctly.

The particles, moreover, appear to be of normal occurrence in the eye, for the appearance of floating muscæ may, in general, be seen by any person by simply looking through a small aperture in a card at the clear sky, or through the eye-glass of a compound microscope at the flame of a candle two or three feet distant, or simply bringing the eyelids towards each other, and looking at a lighted candle.

Nature of the Particles, the Presence of which Occasions Floating Muscæ.—This has not yet been with certainty determined. In the vitreous humor (as also in the aqueous) there is contained a great number of corpuscles, most of them resembling lymph-corpuscles, though smaller, being between $\frac{1}{4000}$ and $\frac{1}{5000}$ of an inch in diameter; but it appears from the calculations of Brewster, Mackenzie, and Reute, that the size of the particles, the presence of which occasions floating muscæ, is much greater than this. Muscæ volitantes are often seen by persons without any particular notice of them being taken, as they are distinct, present themselves occasionally only, and are therefore not troublesome. Their appearance in cataract is owing to the opaque lens acting much in the same way as the perforated card.

They are seen most distinctly, and are, therefore, most troublesome, when there exists an irritable state of the retina, with weakened irradiation. Such a state of the retina may therefore be viewed as the general condition on which floating muscæ, considered as a disease, depend. Dilution of the images of external objects favors, distinctness, on the contrary, prevents the perception of muscæ. Hence, when the person is short or far-sighted, they appear far less evident to him when he uses the glasses fitted to render his vision distinct. This appears to be owing to the stronger impression of the external objects making up for the weakened irradiation, so that the weak impression of the objects of the muscæ is more readily effaced. The pupil of an eye affected with muscæ volitantes is generally contracted, even when the eye is myopic. From what has been said, it will be seen that the occurrence of floating muscæ is of itself no indication that either cataract or amaurosis is taking place. If, however, there be along with the appearance of muscæ a failure of vision, and if that failure be not attributable to myopia or presbyopia, which may be ascertained by a concave or convex glass not improving the vision, then cataract or amaurotic amblyopia may possibly exist.

In uncomplicated cases, the muscæ may indeed increase in numbers, but very slowly, and never to such extent as to interfere with the distinctness of vision in any very troublesome degree. But sometimes the muscæ remain stationary, or even become less. A question which the patient is very likely to put to us is, whether the floating motes or threads which he sees are not liable to increase, and that to such a degree as at length to deprive him of sight. That they increase is true, although only very slowly, and never to such an extent as materially to interfere with vision. Even when the whole field of vision presents entohyaloid spectra, the patient is still able to read, although, as he continues to do so, the muscæ sometimes gather together, so as to render portions of the page before him temporarily obscure. Very often they remain stationary for ten or twenty years, or increase by almost insensible degrees; and although alarming at first, the patient gets habituated to them, and troubles himself no more about them. I believe the increase of myodesopsia arises more from the eye becoming in a greater degree susceptible to the impressions of the bodies which cause the disease, than from any increase of the bodies themselves. This increasing susceptibility arises from over-use of the eyes, and from searching for and examining the muscæ too much.

Many authorities might be quoted, to prove that entohyaloid muscæ increase only with extreme slowness, and sometimes become even less perceptible. "I know many people who have complained to me of such things fifteen or twenty years ago, and who are still in the same state."

"These kinds of phantoms, which increase very slowly during the first five or six years, continue during the whole remainder of life without any kind of inconvenience. * * * I know a great number of persons who have seen them thirty, forty years, and more, without their number or their figure having undergone the slightest change."

"It is certainly for from twenty to thirty years that I have seen these same appearances," says Prevost, at the age of 50; and at the age of 79, he adds: "Since, up to a very advanced age, I have enjoyed very good sight, I may support, by my case, the opinion of the oculists who reckon these appearances of small importance."

"They are quite innocent in their nature, and exist in persons whose powers of vision are most acute. I have been subject to them from childhood."

Treatment of Entohyaloid Muscæ.—Entohyaloid or floating muscæ are not much under control, and are very seldom removed by medical applications. If of old standing, and not increasing, it is needless to interfere. When of recent origin, and the exciting cause evident, they are sometimes cured. The treatment most likely to be useful is as follows:

1st. The patient must be put on his guard against the exciting causes, and carefully avoid them; such as too much straining of the sight, excess of every sort, night-watching, and the use of alcohol in any form or quantity. "The only means which often does good in this disease," says Dr. J. B. Walker, of this city, "is rest of the eyes, and refraining from every employment which strains the sight. I know patients who have got completely free from muscæ volitantes which they had seen for several years, by long-continued rest, which, however, again appeared, as soon as they wrought for some days, so as to strain their sight."

2d. If the stomach is weak and the bowels costive, a course of laxatives, followed by tonics, should be prescribed. To strengthen the constitution, and especially the nervous system, should by every likely means be attempted. This indication will best be answered by cinchona, steel, and the cold bath.

3d. A torpid state of the liver requires small doses of the blue pill, either by itself or combined with purgatives. I have known a gentle course of mercury successful in curing the disease, probably by its sorbefacient powers. Iodide of potassium

I have also found completely successful in removing muscæ volitantes of recent standing.

4th. Where the symptoms of determination of blood to the head are well marked, venesection or arteriotomy, leeches to the head, or cupping and counter-irritation are indicated. Of twelve cases treated by Dr. Schlagintweit, eight, we are told, were cured by solvent and derivative medicines, and by bleeding at the foot.

5th. When muscæ appear to depend on disease of the heart, leeches are recommended, by Mr. Wardrop, to be applied over this organ till its impulse is diminished. The fulfilment of this indication may be promoted by small doses of antimony and the use of laxatives. If the patient complains of cold feet, the warm pediluvium is to be used at bedtime; and it may be remarked that this simple remedy is of great importance, where the disease is connected with a difficulty of obtaining sleep.

An irritable state of the heart, remaining after its impulse is subdued, Mr. Wardrop endeavors to remove by the exhibition of sulphate of iron.

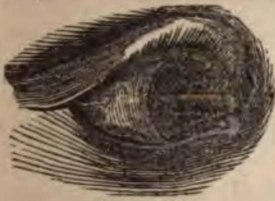
6th. Antispasmodics appear to have been chiefly confided in by Ware in the treatment of muscæ; such as, two or three times a day, a small dose of the volatile tincture of valerian, mixed with an equal quantity of tincture of castor, and joined occasionally with the camphor mixture, or with the infusion of cascarilla.

7th. Exercise in the open air, and a change of residence, and such occupations and amusements as are likely to withdraw the mind from any source of anxiety and distress, are found to be beneficial. A course of mineral waters has sometimes been successful, probably more from the change of scene, hilarity of mind, exercise of body, and regularity of habits, by which such a course is accompanied, than from the effects of the waters themselves.

8th. If the eyes feel hot, heavy, or uncomfortable, they should be bathed with either some cold or warm application, according as the patient feels one or the other more agreeable. Cold water, or a cold lotion, consisting of water with a small proportion of spiritus ætheris nitrosi, will answer in the one case; tepid water, or a tepid infusion of any aromatic herb, in the other. Sponging the forehead, temples, and outside of the eyelids, morning and evening, with a camphorated tincture of rosemary, eau de Cologne, or the like, is also recommended.

CONICAL CORNEA.

The convexity of the cornea varies in different individuals; it sometimes projects so much, in the form of a cone, as not only to diminish but to quite destroy vision. The point of the cone is generally in the centre of the cornea, but it is sometimes situated on the side of it. Authors formerly considered the disease as a thickening of the cornea, but pathological anatomy has shown that it is a thinning of the cornea in that particular part which forms the cone, and that this part yields to the pressure of the aqueous humor. This state of the eye is rarely, if ever, accompanied by inflammation. The patient at first becomes short-sighted, which causes him to partially close his eyes when engaged in examining objects. As the disease advances, he sees objects multiplied, or will not see them at all unless held laterally to the eye.


(Fig. 11.)

If at the commencement of the disease, the surgeon looks straight into the eye, he sees no change in the shape of the cornea; but if he examines the eye in profile, the cone will be observable, shining like a diamond. At first the cone is perfectly transparent, but, after the disease has continued for a long time, it becomes opaque. The disease sometimes begins in one eye, and after a time appears in the other.

Cause.—The cause of this disease is very obscure; it has been met with in every stage of life, but is said to be more frequent in women than in men. Dr. Ammon met with congenital cases of it.

Treatment.—The only treatment that has been found to produce any benefit, is giving the eyes rest, prescribing tonics, and attending to the generul health; benefit will also be derived from the application of stimulating liniments around the orbit. Evacuating the aqueous humor, and using pressure upon the cornea, have been practised, but with very little benefit. Mr. W. W. Cooper was more successful than others in this treatment, by means of an apparatus which he invented for keeping up long-continued pressure upon the eye without producing irritation, at least it produced less irritation than any previous means which have been tried; it was not, however, so successful as to encourage its use. The apparatus was an air-cushion acted upon by a spring, after the manner of a truss.

ADAPTATION OF AN ARTIFICIAL EYE.

When an eye has been partially or wholly exercised, or has atrophied considerably, the appearance of the patient may often be greatly improved by the adaptation of an artificial eye to the stump. The artificial eye has also the advantage of assisting the natural play of the lids, and thus preventing inversion of the lashes and its attendant evils.

Artificial eyes, vulgarly called "eye-limpets," are constructed of glass or enamel. The anterior surface is convex, with a representation of the iris and pupil upon it; the posterior is concave, to adapt itself to the form of the stump. The artificial eye should be thin and light, and it should be so made as to allow of its introduction without causing pain to the patient, and should admit of the perfect movements of the eyelids over its anterior surface. If fræna exist between the lid and the stump, the artificial eye may be correspondingly notched.

The mode of inserting and removing the eye is exceedingly simple. All manipulations should be conducted over a soft cushion, in order that the eye may not be broken in the event of its falling; and before introducing it, it should be dipped in tepid water. To insert it, the upper lid must be drawn upwards with the thumb of the left hand, whilst the upper border of the eye is slid by the thumb and forefinger of the right hand under the lid into the upper palpebral sinus. The lower lid is now depressed, and the eye, with a little manipulation, glides into its socket. In removing the eye, the lower lid is depressed, and the patient's thumb-nail, or a small hook inserted under the eye, which is tilted out of the lower palpebral sinus, and is then easily drawn from behind the upper lid. After removal, which should be done every night, the eye should be dipped in tepid water, cleaned, and carefully wiped. If inflammation of the conjunctiva ensues from the pressure of the artificial eye, its use for a time should be discontinued, and the socket be syringed with cold water or alum lotion. If the insides of the eyelids become the seat of polypoid growths, they should be snipped off with scissors.

EXTRACTS.

[*Lecture on the Physiology of the Nervous System, delivered in 1836, in the College of France, by Magendie.—Lancet, April 29th, 1837. Page 186.*]

"The integrity of both the optic and fifth nerves, then, is indispensably necessary for the exercise of vision, which is lost whenever either of these nerves is separately destroyed."

[*Lancet, May 20th, 1837. Page 299.*]

"Nervous pains of long duration and the greatest intensity have been quickly removed by topical applications to the temporal region."

[*Lancet. Page 280.*]

"Amaurosis cannot be considered as a simple affection of the optic nerve; at least, in the actual state of the science, it is generally impossible to say that the fifth nerve has no connection with the loss of sight, and in many cases the connection is evident. Hence, a rule, which I invariably follow, of addressing my remedies in the first instance to some of the branches of the portal nerve; and I have frequently had the satisfaction of observing some of these cases of incomplete amaurosis improve sensibly under the influence of therapeutic agents applied to the fifth pair. I would go even further, and say, whenever you have a case of incipient amaurosis, commence by acting on this nerve, for it is at once the most expeditious and efficient method. I cannot, however, quit this point without assuring you that no physician is capable of treating diseases of the eye, unless fully in possession of the facts that I have first had the honor of explaining to you. These facts are daily becoming more numerous and more convincing, and already a considerable number of our young practitioners, who devote themselves wholly to the study of diseases of the eye, are fully aware of the immense influence of the fifth pair of nerves over the exercise of vision."

[*Lancet. Page 289.*]

"To resume, then, what I have said concerning the sense of vision and our several experiments, allow me once more to impress you with the idea that sight can never be exercised in a complete and perfect manner without a certain influence of the fifth pair of nerves. Destroy that influence and you destroy vision. This is all we know of the matter, for up to the present moment we have been unable to determine how far this influence extends, or in what manner it is communicated."

OPHTHALMIA.

By the term ophthalmia is meant inflammation of any part of the eye, but more particularly when the conjunctiva is the part affected. There is no term more likely to set the student or young practitioner astray than that of ophthalmia, being applied to every inflammation of the eye, without any distinction as to the part inflamed. I shall endeavor, in as simple a manner as possible, to show what are the diseases to which the term is applicable, avoiding all such divisions and subdivisions as do not lead to any practical result, and carefully adhering to those that do. And here I think it well to remark, that although any one particular part of the eye may become the seat of inflammation, and that of a particular kind, yet, when speaking of inflammation of a part, it is not meant that the inflammation is confined to that part, but that it originated there; for inflammation cannot continue any great length of time in any part of the eye without spreading to other parts, not at first affected.

The phenomena of inflammation, in part, are heat, redness, pain, and swelling. As a general rule, these signs are to be found in inflammation of the eye, but other symptoms are to be found accompanying them, according to the texture inflamed; and in some instances some of these symptoms will not be seen, while in other cases none of them will be observable; hence, the great necessity of describing the inflammation of each part separately. Inflammation of the eye may be either acute or idiopathic; and these may be modified by a peculiarity of constitution. Another distinction which is to be particularly attended to in inflammation of the eye, is its division into chronic and acute; for the means which would subdue the former would have no good effect on the latter. The practitioner must never lose sight of the important difference between inflammation and its consequences; he must also bear in mind that inflammation may be, from the very beginning, of a chronic form, and never partake of the acute, unless such a state is produced by the erroneous interference of those who do not understand the exact phases of the malady.

General Causes of Inflammation of the Eye.—Among the general causes of inflammation of the eye are injuries of every kind, both mechanical and chemical. Either very warm or very cold air will act as an exciting cause. Beers was of the opinion that the quantity of electricity in the atmosphere had much to do in affecting the eye. Among the indirect causes, he enumerates immoderate bodily exercise, violent emotions of the mind, injudicious clothing, and high living. He also considered contagion a more frequent direct cause than infection. It is strange that light, which is indispensable to the functions of the eye, should be a cause of inflammation; nevertheless, such is the case, both as respects its quantity and its quality, but more particularly the latter. All strong artificial lights, or reflected light from red or polished surfaces, are well known to act as an exciting cause of ophthálmia, but it is in a greater or less degree, according to the irritability of the eye.

Dr. Walker, of this city, considered the direction of the rays of light to make a great difference, conceiving that the eye was less capable of bearing them with impunity the more they receded from the perpendicular line, and struck the organ sloping or horizontally. When we consider the position of the eyebrows and eyelashes, acting, as they do, as a shade to prevent horizontal rays from striking the eye, it must be acknowledged that there is some reason in this theory of Dr. Walker's. But he further observes, that every statement concerning light should be only received in a relative sense, for the degree of light which would answer very well for the eye of an African, would destroy the eyes of Europeans; and the same light which is borne without inconvenience by the eye of an adult, would excite in the eye of a new-born infant ophthalmia neonatorum. Why light should produce inflammation in any of the coats of the eye, or how it produces it, I have never found explained by any author. Nor do I wonder at it, when I consider the views taken on the physiology of the eye. Were the retina only the seat of inflammation, it would admit of an explanation; but when we find that the conjunctiva is the part that is generally attacked, we are at a loss to explain how it occurs. I consider that it can be explained in one way only, which is, by granting that the ophthalmic branch of the fifth pair of nerves is sensible to the stimulus of light, and that under particular circumstances, light of a peculiar kind, acting on this nerve, produces a morbid irritabilty of it, and thus acts as an exciting cause of inflammation. [See the Physiology of the Ophthalmic Branch of the Fifth Pair of Nerves.]

There are many other indirect causes of inflammation of the eye, such as the free use of ardent spirits, exanthematous fevers, suppression of the natural discharges, etc. All these causes will be more particularly considered when treating of the peculiar kind of inflammation which they produce. To give any general treatment for inflammation of the eye, I have only to state that it is the same, varying according to circumstances, as that which has been mentioned by every writer on surgery, for inflammation in any part of the body, such as bleeding, purging, nauseants, diuretics, opiates, diaphoretics, mercury, rest, low diet, etc.

CATARRHAL OPHTHALMIA.

Catarrhal Ophthalmia, or Mild Inflammation of the Conjunctiva.—This disease is purely specific, and differs in every respect from all other forms of inflammation of the conjunctiva. It is distinguished from purulent ophthalmia by the comparative mildness of its symptoms; the discharge being much less copious, the pain not so severe, and although the vascularity may be very great, yet it never runs into perfect chemosis, or induces sloughing of the cornea.

Symptoms.—The first symptom is an itching of the eyes, followed, in a short time, by an unpleasant sensation, as though an eyelash or mote had got between the eyelid and the eyeball; which sensation is caused by the rubbing of the eyelid over the enlarged vessels of the conjunctiva. With this vascularity of the conjunctiva there is a copious flow of tears, and both symptoms are much increased by the patient rubbing the eye with his hand. The second morning after these symptoms, the eyelids will be found adhering together, from the increased mucous secretion of the conjunctiva, and the secretion from the meibomian follicles collecting on the edges of the lids, and becoming dry and encrusted from exposure to the air.

If, at this stage of the disease, the eye be examined, the palpebral conjunctiva will be found to have an uniform deep-red appearance, and the sclerotic conjunctiva will be seen to be an equal vascular network, but the vessels not crowded together so as to produce a general redness, as in severe ophthalmia. Chemosis spots may sometimes occur in the vascular network, but true chemosis never exists, for when what might be called chemosis does exist, it is no longer the disease here treated of, but severe inflammation of the conjunctiva.

At the commencement of the disease, the secretion from the conjunctiva is transparent, but it soon becomes opaque, thick, and puriform, and during the daytime is not so visible, being removed, as fast as it is formed, by the great flow of tears; but if the patient remain quiet, with his lids closed for a short time, then, on depressing the lower lid, flakes of matter will be seen floating in the tears. As the disease advances, all these symptoms increase in severity. Exacerbations generally take place in the evening, which, however, are generally followed, and the patient relieved, by a good night's rest. During the prevalence of the above symptoms, vision is not much impaired, but there is an occasional haziness of sight, caused by the tenacious fibres of purulent matter adhering to the cornea.

If the patient be a healthy subject, and the case goes on well, on about the third day the sensation of a foreign body in the eye, and the great flow of tears becomes less frequent, the vascularity not so intense; but the discharge is more freely secreted. Subsequently, all the symptoms gradually diminish and finally disappear, leaving the parts something more vascular than before the attack; but this vascularity disappears in a couple of weeks, leaving the eye perfectly well. Unfortunately, the cases met with in every-day practice are not such as has been just described, as the inflammation is generally modified either by a scrofulous constitution, improper treatment, neglect, deficient food or clothing, and, what is general, a want of cleanliness.

Treatment.—It is, then, only necessary, in the severer cases, to keep the patient in his room. In mild cases, and where the conjunctivitis is subsiding, the patient is much more comfortable in the open fresh air, and he recovers quicker than in a confined room. But he must be warned to avoid wind and dust, and not to visit places which are overheated, or in which the air is impure or smoky. He is especially to be warned against pursuing any occupation over a fire, and to avoid bright light or great contrasts of light, straining the eyes by reading, writing, or sewing, especially by lamp or gaslight; all of which may cause hyperæmia and congestion. Cold compresses, in this stage, should only be used at long intervals, and with the greatest care. They are to be used for cleansing the eyes, and for the removal of the frequent burning, itching sensations, etc. Cloths dipped in cool, fresh water answer this purpose excellently well, while pressure, or rubbing the lids, although pleasant to the patient at the moment, increases the irritation very markedly, and are, therefore, to be carefully avoided.

In the use of astringents, we should remember that they always irritate more or less, and that their therapeutic value depends on this effect. Astringents can, then, only be indicated only where an irritation is desirable of itself, or for the purpose of overcoming a relaxation of tissue and of the vessels. In cases in which neither the irritation nor relaxed condition are very prominent, where it is, therefore, doubtful whether the anti-irritative or astringent treatment be proper, it is advisable to keep on for a few days with the antiphlogistic treatment, or to try the ground with the experimental use of a mild astringent; and in case the latter is not borne, to again take up the antiphlogistic method, and wait till the relaxation is more distinct and the astringents are indicated. Penciling the conjunctiva with a solution of nitrate of silver, five grains to the ounce, does by far the most service. Wherever the relaxation of the tissue is quite prominent in catarrhal conjunctivitis, and the symptoms of irritation do not contraindicate, the treatment should be begun and continued with this remedy, until the relaxation and morbid secretion of the conjunctiva are removed. If, under such a treatment, the morbid condition is subdued, except as to some hyperæmia of the conjunctiva, or if the catarrh from the beginning has been but slight, and the relaxation of tissue little noticeable, or if the patient be not in a position to consult the physician daily and allow the pencilings to be made, the astringent collyria should be advised.

In old, chronic catarrhal conjunctivitis, and, in general, where the relaxation of the conjunctiva and its vessels has reached a very high grade, especially in the habitual catarrhal inflammation of old persons, the treatment above indicated will not be sufficient to attain the desired result. Then, the daily application of a smooth crystal of sulphate of copper to the tarsal portion and the palpebral folds will do very well. But if the patient cannot visit the physician every day, we may substitute an ointment of five grains of sulphate of copper to two drachms of simple cerate, which the patient causes to be introduced, or places, in the conjunctival sac with a camel's-hair brush. If, however, the very much relaxed and loosened conjunctiva is superficially rough, velvet-like, or even granular, it is better to first pencil the conjunctiva daily, for some time. with a solution of ten grains of nitrate of silver to the ounce of water, continuing this until the conjunctiva becomes smoother, when the sulphate of copper, in the form of a crystal or an ointment, may be continued until the end of the treatment.

In order to prevent the formation of crusts and its evil results, the edges of the lids may be cleansed with a piece of soft linen. At night, the lids should be smeared with fresh fat, with glycerine, cream, simple cerate, or the like. It is best to apply the ointment with a brush upon the edges of the lids, and it must be got between the lashes. The application is made when the lids are closed, and the patient should not open them for some time after. The parts should be covered by a thin layer of fat. If, in spite of all these precautions, or on account of insufficient treatment, thick, hard crusts are formed on the edges of the lids, which adhere closely to the ciliæ and epidermis, these should be first completely softened by soaking them in warm water with a sponge or a piece of soft linen; otherwise, their removal will cause excoriations. Lukewarm milk may be used instead of water.

PURULENT OPHTHALMIA.

This disease has received various names, according to the nature of its secretion (ophthalmo-blennorrhœa; conjunctivitis paro-mucosa; suppurative ophthalmia); its contagiousness (ophthalmia contagiosa, M'Kenzie); or from the persons who are chiefly liable to it (Egyptian ophthalmia; ophthalmia lellica; military ophthalmia.)*

From what I have just said respecting catarrhal ophthalmia, the reader will readily perceive how impossible it is to make any definite practical distinction between it and purulent ophthalmia, inasmuch as a severe case of the former and a mild case of the latter offer precisely the same phenomena. The difference between the two diseases appears to be one simply of degree, unless we consider contagiousness to be a distinctive mark of the purulent affection. If seen, then, at the first onset, a case of purulent ophthalmia resembles one of ordinary catarrhal inflammation, but proceeds so rapidly that twenty-four hours are sometimes sufficient to furnish the peculiar signs of the more serious disease—the swollen lids, chemosis, and haziness of the cornea. It is the last-named structure that should chiefly engage the surgeon's anxiety, for, unlike the common catarrhal ophthalmia, which limits itself to the comparatively unimportant conjunctiva, the purulent form rapidly endangers sight, by involving the cornea in its ravages.

In a well-marked case of purulent ophthalmia, the patient is usually pallid, and both physically and morally depressed. The eyelashes are loaded with yellow discharge; the lids are swollen and dusky red, and so infiltrated that the patient cannot separate them sufficiently to expose the cornea. This inability naturally suggests to him the notion that he is literally blind; and it is sometimes important, as a means of raising his spirits, for the surgeon at once to expose the cornea, and convince him that sight is still retained. The conjunctiva is everywhere reddened, infiltrated, and elevated above the level of the cornea, producing the appearance termed chemosis, but usually looking more solid and less watery than in common catarrhal ophthalmia. If this chemosis has proceeded to its fullest extent, it overlaps and completely hides the margin of the cornea, and it may even protrude a little between the lids. The cornea being overspread with thickened secretion, often appears at first sight to be really opaque or hazy; and the surgeon must take pains carefully to wipe away this secretion before pronouncing a positive opinion as to the state of the cornea beneath it. But even then, he can only speak very guardedly, for the ulceration, which in this disease is so destructive, frequently begins at the extreme edge of the cornea, the very part hidden, as I have said, by the overlapping of the chemosis; and it may thus escape detection until it has perforated the entire thickness of the cornea, and caused prolapsus of the iris.

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* The literature of purulent ophthalmia is most extensive. From its prevalence in armies, and other large bodies of men, it has specially attracted the notice of military surgeons; it has formed the subject of several prize essays; and the most celebrated ophthalmic surgeons of Europe have, at various times, published reports on its ravages among the troops of England, France, Prussia, Austria, Russia, and Belgium.

In very severe cases of purulent ophthalmia, this ulceration rapidly advances in the form of a crescentic groove, becoming deeper and wider, until it has isolated the central part of the cornea, which, by that time, has assumed a hazy or even opaque appearance. Then, this central portion likewise yields to ulceration at one or more points, becomes softened, sloughy, and infiltrated with pus; it gives way, the iris bulges through the large opening thus formed, and, eventually, becoming coated with fibrous exudation, assumes the prominent appearance known as staphyloma. The ulceration may stop short of actual perforation, after destroying a large portion of the anterior surface of the cornea, and in such cases the cicatrices formed by the healing of the ulcers remain, ever afterwards, white and opaque; while the rest of the cornea, in consequence of inflammatory deposit and infiltration of pus, never regains its healthy transparency, but, at best, becomes sufficiently translucent to allow a dim view of the iris, not, however, affording the patient any useful sight.

Those attending the practice of our eye infirmaries must be familiar with the aspect of patients whose corneæ have undergone some of the changes I have been describing. Soldiers who have suffered from severe purulent ophthalmia, in India or some of the British colonies, exhibit the most distressing ravages of this disease.

Another result of the inflammation of purulent ophthalmia is slough of the cornea. The chemosis having increased, so as to overlap not only the extreme margin, but the greater part of the anterior surface of the cornea, the latter loses its transparency, becoming at first milky, then yellowish, and quite dull on the surface, and, finally, flabby and perfectly opaque, like a piece of wetted wash-leather. At this stage, the chemosis diminishes, the profuse purulent discharge ceases, and is succeeded by a flow of tears, rendered slightly turbid by a small quantity of mucus, and the patient and those about him are often pleased at the apparent improvement, and flatter themselves with hopes of a speedy recovery, at the very moment when the surgeon knows but too well that sight is lost forever. Still, as long as any portion of either cornea retains its vitality, the case must not be abandoned in despair; for if only a small portion, less even than one-quarter of one cornea, can be saved from destruction, and its transparency retained, useful sight may eventually be gained by the operation of making an artificial pupil.

It was to obviate, if possible, this sloughing of the cornea, that Tyrrell devised, and so warmly advocated, the plan of making radiating incisions through the chemosed conjunctiva. He believed that the swelling of this membrane caused such tension and pressure on the vessels supplying the cornea as arrested the flow of blood, and so induced death of the part. But the operation was based on an anatomical mistake, namely: that the cornea is wholly nourished by vessels prolonged into it from the conjunctiva. Mr. T. W. Jones, in a letter published in the *Medical Gazette*, exposed the fallacy of this theory; and subsequent experience has, I think, decided that these radiating incisions by no means ensure the happy result the inventor of the plan so confidently anticipated. I have frequently tried them, but could never satisfy myself of their contributing towards the cure of the disease.

Two precisely opposite modes of treatment have been adopted in purulent ophthalmia—the depletory and the stimulating. The first was carried to its fullest extent in the various armies of Europe during the late war, and has since been advocated by eminent authorities in civil practice. The opinions of the profession on the subject of inflammation and blood-letting have undergone such a total change, that I need hardly caution the reader against attempting to cure acute purulent, or gonorrhœal ophthalmia, on the principle so strongly urged, only 24 years ago, by one of our most distinguished writers on eye diseases, who, in reviewing a case of gonorrhœal ophthalmia, which had been seen at a very early period of the complaint, and treated by large bleedings, both local and general, records his opinion, as follows: "From the unfortunate termination of this case, * * * * I infer, not that antiphlogistic treatment is incapable of arresting this inflammation, but that it had not been carried to a sufficient extent; and if I had to treat some of these cases again, I should certainly bleed more freely." "As much blood should be taken from the arm as will flow from the vein, and the evacuation should be repeated as soon as the state of the circulation will allow us to get more."

This practice is enforced by the following quotation from Bacot's Treatise on Syphilis: "There are cases which defy all the usual etiquette of regular and ceremonious visits. If we wish to save our patient from the destruction of his vision, we must scarcely depart from his bedside until the inflammatory symptoms are controlled. The lancet must be hardly ever out of our reach, for if ever there was a disease in which blood may be taken away without limitation, it is this."

Mr. Wardop's statement is still more startling: "The only case (of gonorrhœal ophthalmia) he had seen, in which the eye was saved, was that of a young woman, in which venesection was repeated as often as blood could be got from the arm. She had lost 170 ounces in a few days, and looked as if every drop of blood had been drawn from her body; the skin having nearly the hue of a wax candle."

Can we wonder that thousands of persons with that tendency to rush into extremities, which is one of the infirmities of our nature, should seek refuge from such treatment under the milder discipline of Homœopathy? If the treatment of purulent ophthalmia by excessive depletion be judged by its results —the only sure test—we shall, I think, be forced to confess that there was ample cause for trying some less violent means of cure.

It has been suggested that the more temperate habits of the mass of the people at the present day, as compared with what existed fifty years ago, may exert a considerable influence over the inflammatory manifestations of certain diseases, and that those surgeons who describe purulent ophthalmia as they saw it at the commencement of the present century, had really sometimes to contend with a greater fulness and force of circulation in their patients than we are in the habit of witnessing, especially among the overworked and crowded population of our larger towns. Certain it is, that, as far as my own experience in traveling through large cities enables me to form an opinion as to the general condition of patients suffering under purulent ophthalmia, I should say that they are uniformly more or less depressed, with a pulse more feeble than natural, and in a state which in every way contraindicates general bleeding, and calls for the administration of tonics. There is usually a coated tongue, with loss of appetite, and a brisk purgative is needed at the very outset of the treatment. Afterwards, either bark and ammonia, or quinine, should be given, and hyoscyamus if the patient be restless. Pure air—to many the best of all tonics—must, if possible, be obtained; and all unnecessary confinement to bed, or to one room, avoided. Meat may be allowed once a day, and a moderate quantity of beer or wine; but on this head no arbitrary rule can be laid down. The surgeon's judgment must guide him as to the cases in which he ought to forbid stimulants, use them in moderation, or even to insist upon an extra quantity being taken.

Treatment.—The surgeon should never forget that the purulent process is a very changeable one; that the severity of the inflammation, and the quality and quantity of the secretion, often change very much in a short time, and thus alter the indications. What is indicated in the morning may be contraindicated at noon, and be urgently required again in the evening. It is seen from this, that it is not sufficient to see the patient once or twice a day, to prescribe for half a day in advance, and then leave the carrying out of the orders to unintelligent attendants; he who treats his patients in this way will have bad results. It is imperatively necessary to see the patient often, to attentively weigh all the indications, and to use the remedies with the greatest care. Those about the patient should be warned from any unnecessary contact with him, or with anything that he uses. The attendants should see to it that, after each assistance they render the patient, they wash the hands with soap and water, and especially avoid any contact with their own eyes. The linen of the patient, and especially the bed linen, the handkerchiefs, towels, etc., are only to be used again after boiling with soap and water.

1st. Cleaning the Eyes.—The first point in the local treatment is to clean away, completely and frequently, in the course of the day and night, the puriform discharge. This is to be done with a small piece of soft, clean sponge, while the patient lies on his back. The fluid which I recommend is a tepid solution of 1 grain of corrosive sublimate, with 6 grains of sal ammoniac, in 8 ounces of water, to which are occasionally added 1 drachm of vinum opii. This not only cleans the eye, but acts as a gentle astringent. It is still more efficient to inject the same collyrium into the sinuses of the conjunctiva with a small syringe, the fluid being sent over the whole surface of the diseased membrane with considerable force; and especially into the fold between the eyeball and the upper lid. The surgeon must be careful in inserting the syringe between the eyelids not to press upon the cornea.

2d. Astringents—Escharotics.—With regard to other astringents, my experience leads me decidedly to condemn sugar of lead, in whatever form; nor can I speak favorably of sulphate or acetate of zinc. Some highly recommend a solution of alum, while others trust to solid sulphate of copper, rubbed over the internal surface of the eyelids. I consider a solution of nitras argenti as the best remedy for constringing the inflamed vessels, allaying the painful feeling of sand in the eye, and lessening the discharge. I have tried this solution in various degrees of strength, and consider 5 to 10 grains to the ounce of simple distilled water, as recommended by Dr. Ridgway, to be, in general, the most suitable. The solution may be applied every five or six hours, or as soon as the raw, painful feeling in the eye is renewed. It is to be taken up with a pretty large camel's-hair pencil, with which first the inside of the upper eyelid is to be well brushed, and then that of the lower, not omitting any of the folds formed by the chemosed conjunctiva. We generally find a very marked improvement in the course of 24 hours under the use of this application. Circumstances may lead the practitioner to vary the strength from 2 to 10 grains. It may be well to begin with it weak, and see how it agrees. If weak, it may be used oftener. Should it disappoint our expectations, and the purulent discharge run on unabated, recourse may be had to a salve containing from 10 to 15 grains of the nitrate of silver in an ounce of axunge, or the inside of the lids may be touched rapidly with the lunar caustic pencil. Some practitioners trust almost entirely to this last means, to the exclusion even of depletion of any kind. They apply it once or twice a day chiefly or only to the inside of the lower eyelid. I conceive that if only caustic is employed, without depletion, the eye is very likely to be lost. Depletion enables us to use astringents and escharotics with more effect and less danger. Red precipitate salve, of the strength of 10 or 15 grs. to the ounce of axunge, has been found useful as an application to the conjunctiva, and may be substituted for the preparation of lunar caustic.

These two local applications, the nitrate of silver solution and the corrosive sublimate wash, cannot be managed by the patient himself, and can rarely be trusted to a nurse; they should be applied by the practitioner. If crusts have formed on the lids and lashes, they should be softened by applications of cold water before they are removed; tepid water should not be used until the cold applications have been abandoned. When there are excoriations, castor oil and glycerine, equal parts, applied to the eye every evening, is found to be an excellent remedy.

Opiate Fomentations and Friction.—Considerable relief to the pain of the eye is sometimes obtained from allowing the steam of hot water with laudanum to rise into the eyes from a teacup; or from fomenting the eyes with a decoction of poppy-heads. Rubbing the head with warm laudanum, when the circum-orbital pain threatens to commence, is also highly useful.

Dilation of the Pupil.—Although it is rarely the case that adhesions of the iris form in any of the puro-mucous ophthalmias, unless to the cornea in case of penetrating ulcers; still, in case adhesions should occur, it is proper to paint the eyebrow and eyelids with the extract of belladonna, so as to dilate the pupil. This ought always to be done when ulcer of the cornea occurs.

Solid Caustic to Ulcers of the Cornea.—In cases of ulcers of the cornea, much advantage is derived from the use of the lunar caustic pencil, sharpened to a point, and applied for an instant to the spot. The good effects of this application are often very striking, where a small portion of the iris protrudes through an ulcer. Yet this is a practice not altogether exempt from danger; for if a myocephalon is touched with caustic, the aqueous humor is apt to be discharged; the cornea, consequently, becoming flattened, may not again become plump, and hence vision will be permanently impaired.

Vinum Opii.—When the purulent discharge is gone, or nearly so, the vinum opii, pure or diluted, proves an excellent application to the relaxed conjunctiva. It is sometimes advantageously combined, in this stage of the disease, with a solution of the lapis divinus.

In hospitals, care should be taken that there are not many persons put together in one ward. The rooms should be kept as clean as possible, well ventilated, not overheated, and protected from bright and irregular light by curtains and lampshades. The patient himself should be kept as quiet as possible.

PURULENT OPHTHALMIA IN INFANTS.

We must ever bear in mind that in this Ophthalmia, just as in the Purulent Ophthalmia of adults, it is upon the degree to which the cornea is involved that the whole importance of the disease depends; and his chief attention, when an infant is first examined, should be fixed on the clearness or opacity of that structure, and not on the more obvious appearances of redness, swelling, and purulent discharge which the eyelids present. Various theories of the origin of this ophthalmia have been suggested,—some regarding it as a mere catarrhal affection; some as due to actual contact with leucorrhœal discharge of the mother in parturition; while others attribute it to irritating substances applied soon after birth, or to other causes. It seems probable that the marked difference of symptoms observed in infants suffering from this disease is due to the exciting cause not being in all instances the same; and that, as in adults, we meet with purulent discharge from the conjunctiva in simple catarrhal, in the "purulent," specially so called, and in the most severe, or gonorrhœal, ophthalmia, just so do the milder cases of the disease now under consideration arise from exposure to draughts of cold air, and sudden changes of temperature; while contact with leucorrhœal or gonorrhœal matter may give origin to those severe cases, in which rapidly destructive ulceration of the cornea dooms the unhappy child to life-long blindness. In a case of ophthalmia neonatorum, the surgeon is so deeply interested in forming an accurate diagnosis, both to satisfy the parents and to preserve his own reputation, that he should spare no pains to ascertain the precise condition of the cornea. For this purpose, having properly secured the child's head, he should endeavor carefully to separate the lids without everting them. This is often extremely difficult, especially when the palpebral opening is small, and the lids offer but a very small surface to the point of the finger. With a bit of moistened lint the creamy matter, which oozes out as soon as the lids are drawn apart, is to be wiped away, and the surface of the cornea thoroughly examined. Occasionally it will happen, especially if a strong astringent lotion has been dropped into the eye, without any regular cleansing with the syringe or otherwise, that some of the secretion becomes coagulated, and is found overlying the cornea, like a piece of wetted wash-leather, resembling very closely the appearance of a sloughy cornea. I have sometimes had to remove with forceps such a layer of solidified secretion (which, on hasty inspection, might have been mistaken for a slough), and have found the cornea itself sound and clear.

The conjunctiva of the lids is always red and villous. The secretion varies much, both as to quantity and color. It has a deep yellow tinge, if the child be jaundiced. The lids are red and swollen during the acute stage of the severe form of inflammation; but they commonly become flabby, and lose their redness, when softening and ulceration of the cornea have fully set in. The disease, as may readily be supposed, attacks both eyes, although an interval of a day or two, or even more, may elapse before the second eye suffers.

But if the attack be a severe one, all local means prove unavailing, unless the child be well nourished: the health of the mother, therefore, and her ability effectually to suckle the child, are most important points for the surgeon's consideration. For the real danger of the disease consists, not in the profuse discharge, which so much alarms the uninformed, but in the liability of the cornea to undergo extensive ulceration. This morbid process it is which destroys those eyes which are said to have been lost by purulent ophthalmia. The cornea, in such cases, first becomes dull and hazy, then opaque towards the centre, with softening of its tissue; and, finally, an ulcer forms, which soon perforates the whole thickness of the cornea; the iris prolapses; perhaps, if the ulcer be very large, even the lens and part of the vitreous humor escape; and the eye ultimately shrivels to a mere nodule. It depends upon the severity of the disease, but even more, I believe, upon the general vital power of the child, whether purulent ophthalmia prove merely a troublesome complaint, or a calamity which impairs or even wholly destroys sight. During that early part of life at which the disease shows itself,—commonly three or four days, almost always within the first week, after birth,—the interchange of material in the system is so active, and there is such a power of forming new tissues, that, if this power be only sustained by suitable treatment, it is quite astonishing to see how rapidly a large ulcer of the cornea will heal up, and with how slight an amount of opacity. When this favorable change sets in, the peripheral portion of the cornea acquires a faint pink tint, from the vessels carrying blood to repair the breath.

Treatment.—1st. As it is of the utmost importance to remove the purulent discharge from time to time, in the course of the day, I may be excused for explaining minutely how the eyes are to be cleansed.

Unless the discharge is removed with regularity and care, other means will fail in curing the disease. The surgeon lays a towel over his knees, on which to receive the head of the child, which the nurse, sitting before him, lays across her lap. Every person bringing a child with ophthalmia neonatorum to an eye infirmary, should be supplied with a separate bit of sponge for cleaning the eyes, lest, by using the same sponge for different children, we may reinfect the eyes when they are beginning to get better. The fluid which I commonly use for washing the eyes is a tepid solution of 1 grain of corrosive sublimate, with 6 of sal ammoniac, in from 8 to 12 ounces of water. The lids are opened gently, and, with the bit of sponge, the purulent discharge which gushes out is removed. The lower lid, and then the upper, are next everted, and wiped clean with the sponge. The upper lid has a tendency to remain everted, especially if the child cries. This is overcome by pushing the swollen conjunctiva into its place, and bringing down the edge of the lid. All this ought to be repeated three or four times, or oftener, in the 24 hours, by the nurse, or by the surgeon. Washing out the discharge with a syringe is more effectual; but the surgeon only should attempt this, and if he does so, should guard against the fluid injected spirting, along with the discharge, into his own eyes. The impetus, however, with which a fluid is sent to the cornea by a syringe is not altogether free from danger, but is apt to bring on or to increase ulceration. The use of the sponge is sufficient and safe.

2d. The corrosive sublimate collyrium, used in cleaning the eyes, tends gently to repress the discharge. Alone, however, it is not sufficient for that purpose, and we have recourse, therefore, to astringent applications of more power. The solution of nitras argenti is what I have found most useful. The strength of the solution should vary, according to the state of conjunctiva and the duration of the disease, fron 2 to 10 grains to the ounce of distilled water. In recent cases, where there is little thickening of the conjunctiva, a weak solution is to be used; when the disease has gone on for a week or more, and the membrane has already become hypertrophied, a stronger solution will be required. With a large camel's-hair pencil, the solution is to be applied to the whole surface of the inflamed conjunctiva, immediately after it has been cleaned as above described. This application ought to be repeated every six or eight hours. Not only the local, but even the constitutional good effects of removing and restraining the purulent discharge are very remarkable. The first night after the use of collyrium and drops, we generally find that the infant has been much quieter than it had been when the disease was neglected. In two or three days the eyes begin to open; and in ten or twelve the acute symptoms are overcome.

3d. To prevent the eyelids from adhering together, yellow oxide of mercury, mixed up well with glycerine ointment, or castor oil and glycerine equal parts, is found to be an excellent remedy; melted on the end of the finger, it is to be applied along the edges, whenever the child goes to sleep.

4th. The above remedies are perfectly sufficient to remove this disease, if had recourse to within two or three days after the first symptoms have shown themselves. I have seen two applications of the nitris argenti solution, *viz.:* on the third or fourth day after birth, on the first and second days of the disease showing itself, remove the complaint completely, although thick white matter was flowing from the conjunctiva. In cases attended by a discharge less distinctly puriform, the use of yellow oxide of mercury ointment at bedtime has sometimes been sufficient. In cases, again, which have been neglected for perhaps 8 or 10 days, it is necessary to take away blood from the external surface of the upper eyelid by the application of a leech, or from the inflamed conjunctiva by scarification. The former may be tried in the first instance; and unless followed by marked abatement of the redness and swelling on the inside of the lids, the conjunctiva may next day be divided with a lancet. The taking away of blood in either of these ways is productive of much benefit, and ought by no means to be omitted, if there be much swelling of the lids, any tendency to chemosis, or haziness of the cornea. A more profuse loss of blood than can be obtained by the methods here recommended, I do not consider necessary. It may be proper, however, to leech or to scarify repeatedly.

5th. Should the conjunctiva threaten to assume the sarcomatous or granular state, scarification should be used, after which, if there is no ulceration of the cornea present, the inside of the lids may be rubbed with a smooth bit of sulphas cupri. For the same purpose, a salve containing from 2 to 6 grains of nitrate of silver in 1 ounce of axunge may be applied to the palpebral conjunctiva; or the membrane, being wiped dry, may be rapidly touched with the lunar-caustic pencil. The latter application generally produces considerable pain and swelling of the lids, which subside under the use of cold wet compresses. The medicated stick, 1 part nitrate of silver and 2 parts nitrate of potash, is also a valuable application in granular conjunctiva.

6th. None of these strong applications are to be used, if the cornea is affected with ulceration. In this case, the solution of nitrate of silver should be omitted, and the eye brought under the influence of belladonna, by painting the lids with the moistened extract. We may further the same object by infusing 1 drachm of the extract of belladonna, or dissolving 2 grains of the sulphate of atropia, in every 8 ounces of the corrosive sublimate collyrium. It is not for the mere dilation of the pupil that the belladonna or atropia is to be used, but to obtain the influence of this anodyne over the ulcerated cornea. Much experience has convinced me of its efficacy, in inducing a healing action in the cornea when affected with ulceration. Many eyes, which seemed, from the extent and depth of the ulcer present, to be doomed to destruction, have to all appearance been saved by its careful employment. Even in cases of perforated cornea, I have seen the ulcer begin to fill up, and ultimately heal, without any adhesion of the iris, under the influence of belladonna.

7th. A remedy of considerable service in this disease is the application of blisters behind the ears. A bit of candle-wick, covered with cantharides plaster, and laid into the angle between the head and the external ear, is a convenient mode of breaking the skin; and by continuing this application either constantly, or several hours daily, a continued discharge will be procured. As soon as there is a discharge of matter from the blistered parts we perceive an amendment in the state of the eyes. If, however, the ears are allowed to get well, we often observe a renewal of the inflammation, and a more copious flow of matter; but the symptoms again subside if the blisters are reapplied.

8th. A dose of castor oil occasionally will be found useful.

9th. Small doses of calomel are highly beneficial; from half a grain to a grain daily will be sufficient. Besides acting favorably on the conjunctiva, this remedy is likely to counteract the tendency to capular cataract.

10th. In threatened disorganization of the cornea, Mr. Jones, of London, strongly recommended the extract of cinchona. The sulphate of quinia answers better, and is more easily administered. From half a grain to a grain may be given thrice a day.

11th. The relaxed conjunctiva, after the purulent discharge has entirely subsided, may be advantageously touched, once a day, with vinum opii. I have sometimes treated cases with the vinum opii throughout, but I consider this remedy as more applicable for the chronic stage of the complaint than for the acute. It serves to clear the cornea from the opacities so apt to be produced by this disease.

12th. The child should be nourished by the breast alone; giving it food often seems to keep up the disease. The mother's or nurse's diet should be carefully regulated. During the acute stage of the ophthalmia, she should take little or no animal food, and should take neither wine, spirits, nor ale. After the acute stage is over, should the conjunctiva continue relaxed, tincture of iron may be given to the nurse with advantage to the child. In several instances, I have known ophthalmia neonatorum attack one child after another of the same parents. Such cases I suspect to be generally leucorrhœal.

SCROFULOUS OPHTHALMIA.

Strumous Ophthalmia. — Phlyctænular Ophthalmia.

Perhaps there is hardly an eye disease less correctly named than the well-known irritable form commonly called "Scrofulous Ophthalmia;" for, although it is very frequently met with in patients who afford decided evidence of a scrofulous constitution, it undoubtedly affects others who have never shown any such tendency; and, again, the cornea is the tissue in which the disease especially manifests itself, not the conjunctiva, which the conventional meaning of the word "ophthalmia" would imply to be primarily affected. We must, however, retain the old term until an unexceptionable substitute has been suggested, only taking care not to confound the disease with mere conjunctival inflammation, or to suppose that medicines of specific action against scrofula (if any such there be) can afford a substitute for that general dietetic and other treatment which has for its aim the strengthening and soothing of an enfeebled and irritable system.

Scrofulous ophthalmia is chiefly met with in patients above two years of age, and below puberty. The most prominent symptom is extreme intolerance of light (photophobia), and the lids are often so forcibly closed, by involuntary spasm, that it requires all the surgeon's tact to obtain a thorough examination of the eyeball. Frequently, the evidences of local inflammation in the latter are trifling, as compared with the distress evinced by the patient. We find on the cornea a small cloudy speck, an ulcer, or a slightly elevated whitish point, like a minute pustule; or there may be several such morbid appearances. But whatever form the inflammatory deposit or the ulcer may assume, we invariably trace an opaque pinkish streak, formed by a lash of fine vessels, extending to it from the edge of the cornea. Should the cornea be more deeply affected, it becomes hazy throughout, and traversed by vessels in various directions; or softening, and deposit of pus, may occur within its substance. The sclerotic exhibits more or less of the pink zone, in proportion as the corneal inflammation is more or less considerable. The conjunctival injection is chiefly seen in the enlargement of the veins running in the course of the recti muscles. The secretion of tears is very abundant, and they gush out every time the lids are drawn asunder. Violent sneezing often attends the admission of light to the eyes, especially in those truly scrofulous patients whose nasal membranes are in a constant state of unhealthy irritability, with an over-secretion of mucus. Swelling of the lips and alæ nasi, fissures about the nostrils and behind the ears, various forms of impetigo and eczema, and enlargement of the cervical glands, are all accompaniments of inflammation of the cornea in scrofulous subjects.

There is no disease of the eye so tedious, so liable to relapse, and in all respects so trying to the surgeon's patience, as that now under consideration; and in a work like the present, I can but indicate the chief heads of treatment.

I generally commence the treatment with an emetic, either of ipecacuanha or tartar emetic, and uniformly with good effects. Four grains of the latter being dissolved in six ounces of water, a tablespoonful is given every five minutes till free vomiting is produced. In cases where there is considerable quickness of pulse and heat of skin, I frequently put the patient on a course of nauseants, or of emeto-cathartics. For instance, to an adult, a mixture may be given of from one to four grains of tartar emetic, with one to two ounces of sulphate of magnesia, dissolved in a pound of water. Of this solution, two or three tablespoonfuls may be taken every half-hour till vomiting is excited; after which, the dose is to be repeated at intervals of three, four, or six hours, as circumstances may require. This is the method to be followed in acute cases.

In chronic cases, the nauseant may be exhibited at longer intervals. It may then be conveniently exhibited in pills; each pill containing from one-quarter to one-half a grain or more of the tartar emetic. To children, the same solution of tartar emetic and salts may be given, or a solution of tartar emetic by itself, or powders of the same rubbed up with a little sugar. From one-twelfth to one-sixth of a grain may be given, according to the age of the child, thrice a day. When there is much febrile excitement, this plan will often prove effectual, while purgatives or tonics would produce little or no good.

Purgatives.—In children laboring under phlyctenular ophthalmia there is commonly a full and hard abdomen, and a loaded state of the stomach and bowels. Even in feeble and emaciated children, it will usually be found that, by the exhibition of purgatives, a large quantity of murbid feculent matter will be discharged. In such cases the administration of purgatives is followed by marked benefit; and without these, other medicines avail but little. In recent cases, a purge of calomel, with jalap, rhubarb, or scammony, will often be sufficient to remove the attack of ophthalmia altogether. Such a purgative is to be repeated at intervals of two, three, or more days, according to the urgency of the symptoms. It not only empties the bowels, but reduces very powerfully the impetus of the blood in the affected part, increases the action of the absorbents, and restores to a healthy state the sections of the digestive organs. It proves in short, alterative as well as depletive;

and its use as such may be persisted in, in many cases, for a length of time, with very decided benefit. I have found a powder, containing from the sixth to the third of a grain of tarter emetic, with from five to ten grains of rhubarb given each night, to be of much service. The purgative plan is more useful than any other in those cases in which an impetiginous eruption over the body accompanies the affection of the eyes. Care, however, must be taken not to push its debilitating action too far.

Sulphate of Quinia and other Tonics.—In scrofulous ophthalmia it is of great importance to remove the debilitated state of the patient; for unless this is done, the eye will not recover. We attempt to increase the strength of the patient, chiefly, by improving his powers of digestion. This is often accomplished by the remedies mentioned under the last head; and especially by the use of rhubarb, which both keeps the bowels regular and improves the action of the stomach. There are several other remedies, belonging more decidedly to the class of tonics, which prove strikingly beneficial in the treatment of phlyctenular ophthalmia.

After a trial of many internal medicines in this disease, I have found none so useful as the sulphate of quinia. It exercises a remarkable power over the constitutional disorder which attends this ophthalmia, and thereby over the local complaint. The dose which I employ is, generally, a grain thrice a day; in very young children, half a grain; and in adolescents or adults, two grains. It may be given rubbed up in a little sugar; but it appears to act best when administered in solution. For this purpose, I use the acidum sulphuricum aromaticum, to which I add a sufficient quantity of syrup and water. In most instances, the effects are very remarkable. Although I have met with a few cases which appeared to resist its beneficial influence, in most of the little patients to whom I have administered sulphate of quinia, it has acted as a charm; abating, commonly in a few days, the excessive intolerance of light and profuse epiphora, promoting the absorption of phlyctenulæ and hastening the cicatrization of ulcers of the cornea. As soon as the stomach has been cleared by an emetic, and the bowels put to rights by repeated doses of calomel with rhubarb, or some other purgative, the use of this medicine may be begun, unless the pulse is very quick and the skin hot, when small doses of tartar emetic will be preferable; or where an impetiginous eruption is observed on the surface of the body, in which case a course of purgatives ought to be adopted.

As internal remedies, Dr. J. B. Walker, of this city, places in the very first rank, a solution of iodide of lime with protoxide of iron. Dose: from half a teaspoonful to a teaspoonful twice or thrice a day.

We may set down the cold plunge or shower bath as a very efficient tonic in scrofulous ophthalmia; but it is not to be employed till after the acute symptoms have subsided. It proves one of the very best means for preventing relapses. The employment of tonics, both medicinal and dietetical, must be continued long after all the inflammatory symptoms have disappeared, in order, if possible, to communicate to the constitution that degree of vigor, which may enable it to resist any tendency to relapse, which may still linger in the eyes, and which, were this precaution not adopted, might, on exposure to the slightest exciting cause, lead to a new and severe attack. We may class change of air among the tonic remedies for this disease, or rather among the preventives which are to be employed after the first attack is subdued. A dry, warm, inland situation is preferable to the sea-cost. The glare from the sea is very apt to aggravate slight attacks, and give rise to relapses.

Antacids.—There is reason to believe that phlyctenular ophthalmia frequently depends on acid generated in the stomach, whence proceeding into the bowels, it mixes with the bile, and produces green stools and general irritation. The teeth, in such cases, are apt to become carious. Under these circumstances, relief may often be obtained by using antacids such as magnesia, its carbonate, or a mixture of rhubarb and bicarbonate of soda, in small doses frequently repeated. Carbonate of ammonia, with tincture of gentian, as recommended by Dr. Charles Armstrong, in common cases of scrofula, may also be employed, with good effect.

Mercury.—Calomel is very often administrated in phlyctenular ophthalmia; more frequently, however, as a purgative than as an alterative. That this medicine is often injurious to children does not admit of doubt. That their constitutions are shattered by an indiscriminate use of calomel, and that in this way they are rendered more susceptible of suffering from the exciting causes of scrofula, is a truth which is too much overlooked. Given as an alterative ophthalmia, I have frequently known mercury prove injurious, because mistimed, that is to say, it was administered before the irritation attending the acute stage of the disease was moderated by depletion. After local blood-letting, and the use of evacuants, we sometimes find decided advantage from the exhibition of blue pill, or even of calomel with opium. In some cases this combination may be pushed with advantage, till the mouth is affected.

Prognosis.—As there is no disease of the eye more liable to a relapse than this, or one that more depends upon the careful attention of the friends of the child, great caution must be observed in giving a prognosis. The practitioner must by no means make light of the complaint, and lead the friends of the child to believe that the case will soon get well, for there are many uncontrollable causes to prevent it, and if his prognosis does not turn out to be correct, he is sure to be blamed; therefore, he should plainly tell the friends all the dangerous consequences which may result from the disease, that there is no security against a relapse, and that the cure may be tedious under the most favorable circumstances.

Treatment.—As a general rule, perhaps there is not one disease of the eye less under control of the practitioner than strumous ophthalmia, nor is there one which is subjected to more various modes of treatment, all appearing equally successful at one time, and unsuccessful at another; indeed, like inflammation of other parts modified by scrofula, it will at some period successfully oppose the very directed treatment. The surgeon must always bear in mind that this disease is dependent upon a constitutional cause, the removal of which must claim his chief attention, while he does not neglect the local treatment.

Believing, as I do, that the nutritive powers of the diseased eye are diminished, I cannot recommend blood-letting in any, nor any other debilitating remedies. However, there are those who recommend the application of leeches.

Mr. Mackenzie says: "When the inflammatory action runs higher than ordinary, or when it is suddenly or violently augmented by the formation of ulcers on the cornea, it is proper to moderate the impetus of the blood by the application of leeches to the eyelids or temple." I do not think the surgeon can commence the treatment better than by giving the following advice to the friends of his little patient, *viz.:* If the child is living in an impure atmosphere, let it, if possible, be removed to a pure one; let him be well clad particularly with flannel next the skin, and let him have good, nutritious food. Pay particular attention to cleanliness, and keep the child in a large, well-lighted, and moderately warm room, and let him be brought out into the pure air when the weather is fine. He should be encouraged to play with his companions, and not allowed to keep his head buried in his nurse's lap, or on her shoulder; even when in bed he should be made to lay upon his back, having his head raised by means of pillows. If the practitioner can get the friends of the child to attend the above directions, he will have accomplished the most important part of the treatment.

Diaphoretics.—Keeping up a healthy action of the skin is of much importance. This may be promoted by the wearing of flannel next the skin, and by the use of tepid bath every night, or every second night. The warm bath often greatly relieves the intolerance of light. It proves soothing and refreshing, and ought to be frequently employed. A tepid salt-water bath is highly useful. The tepid pediluvium every night, for weeks or months together, proves very serviceable; also warm fomentations of the belly, as in infantile remittent fever. Dover's powder at bedtime sometimes proves useful, by exciting a healthy action of the skin, as well as soothing irritation and procuring sleep. In cases where the perspiration is immoderate, this medicine is not less remarkable for its good effects than where the surface of the body is dry and husky. Tartar emetic operates also with good effect on the skin, and sympathetically on the conjunctiva.

Local Treatment.—Finding that veratria was recommended by Dr. Turnbull for the cure of neuralgia, gout, rheumatism, and some forms of paralysis, I was induced to try it in various cases of disease of the eye, where I could trace the affection to any disordered state of the ophthalmic branch of the fifth pair of nerves; and I have found it productive of the very best effects. Its immediate effects, in strumous ophthalmia, are to remove the morbid irritability of the extreme filaments of the fifth, and thus to get rid of the painful sensibility to light, profuse lachrymation, and blepharospasmus; and this is doing much towards accomplishing the object in view. I believe it even does more than this; for, by giving the nerve its healthy action, it restores the nutritive properties necessary for a healthy eye. The manner in which I use this remedy is by brushing the eyelids, eyebrows, and temples with a ⅛-grain solution of it, till a slight burning sensation is produced in the parts. I repeat the application three times a week, until the pain, blepharospasmus, and intolerance of light are removed. Great caution is necessary, in its application, not to let any of it get on the conjunctiva, for such an accident will produce great pain, and do no good. If the use of it is found to produce twitching of the muscles of the face, it should be at once desisted from. Tincture of iodine painted behind the ears, and on the temples, and the eyelids, very carefully, so that none of the liquid runs into the eyes, is sometimes even more efficacious than blisters in subduing the intolerance of light. In most cases it may be repeated twice a week.

Fomentations.—When the symptoms are in any degree severe or of long continuance, warm soothing applications will be found more useful than cold ones. By means of a piece of sponge or flannel, the eyes may be fomented, several times in the course of the day, with a decoction of chamomile flowers, poppy-heads, or digitalis leaves, or with a watery infusion of opium, heated to about 100° Fahr. Much relief is experienced from exposing the eyes to the steam of warm water, or the vapor of laudanum or camphor, raised by means of a cupful of hot water. Belladonna and hyoscyamus, in vapor or in fomentation, are of great service in relieving the intolerance of light. A solution of 1 grain of corrosive sublimate and 6 grains of sal ammoniac, in 6 ounces of water, with 1 drachm of vinum belladonna, or from 1 to 2 grains of sulphate of atropia, is the collyrium which I have found the most useful; a tablespoonful being mixed with an equal quantity of hot water. It is to be used three times a day; and after the eyelids are carefully bathed with it externally, for the space of five minutes, a little of it ought to be allowed to flow upon the eye. Scarification of the inside of the eyelids, especially in chronic cases, where the palpebral conjunctiva is much loaded with red vessels, will be found one of the most valuable means of cure. In cases of vascular speck, division of the fasciculus of vessels running over the sclerotica to the albugo, can scarcely be dispensed with; no other remedy having the same power in checking this very annoying and dangerous symptom.

Counter-Irritation.—In scrofulous subjects, we frequently find that the occurrence of disease in one part relieves another part which was previously suffering. Imitating this natural conversion of disease, when we find other means to fail, we employ blistering in scrofulous ophthalmia, and generally with great benefit. The intolerance of light is often suddenly removed by this remedy; the child being enabled, in a few hours after the blister rises, to open its eyes, although it had not done so for months before. The temples, behind the ears, the crown and back of the head, and the nape of the neck, are the situations generally chosen for the application of blisters. The last is the most painful, but not the least ineffectual. In general, the discharge ought to be kept up, by the use of some stimulating dressing; or, if this is not done, a quick succession of blisters ought to be employed. Friction on the nape of the neck with tartar-emetic ointment is sometimes had recourse to in this disease, for the purpose of bringing out a crop of pustules. This is a practice much more painful than blistering: the pustular eruption sometimes spreads over the body, and causes considerable constitutional disturbance; the pustules, if of considerable size, leave indelible pits, and, from mismanagement of the remedy, large portions of the skin are sometimes made to slough; so that, on the whole, blistering is preferable.

Stimulants applied to the inflamed surface of the eye, in this disease, are decidedly useful. Indeed, it is scarcely possible to effect a cure without them. The impetiginous state of the conjunctiva, or, in other words, of the skin covering the eye, in this ophthalmia, not merely bears stimulants, but, like most other chronic cutaneous diseases, is benefited by their application, if they be well chosen, carefully used, and properly timed. They often act as the best local sedatives, if applied after the acute inflammatory excitement is subdued by the general remedies already enumerated. Employed before this is effected, they will scarcely fail to prove hurtful. In this respect, the treatment of phlyctenular ophthalmia is directly contrary to that of the puro-mucous inflammations of the conjunctiva; for in them we employ stimulants from the very first, but in the phlyctenular we must wait till the symptoms of irritation are somewhat abated.

Various stimulants have been used in scrofulous ophthalmia; but the nitras argenti solution and yellow oxide of mercury, 4 to 5 grains, mixed up well with 1 ounce of glycerine, are the most deserving of confidence. Next to them I would place the vinum opii. Whichever be selected, its application must be continued with regularity once a day, or once every two days, the child being laid in a horizontal position, the head fixed between the knees, and the lid opened so as fully to expose the diseased membrane. The solution of 4 grains of the nitras argenti in 1 ounce of distilled water is the stimulant which I generally employ. It evidently possesses very considerable power in abating the vascularity of the conjunctiva, hastening the absorption of phlyctenulæ, promoting the cicatrization of ulcers, and clearing specks of the cornea.

The relief which it affords to the intolerance of light is not the least of its good effects. We not unfrequently observe that a single application of this remedy will effect so much relief that, by next day, the patient is able in a moderate light to keep the eyes half open, without uneasiness, although previously he could not bear the least accession of light. In producing this effect, it probably operates by inducing the healing of minute ulcerations, and the contraction of enlarged bloodvessels, both of which give rise to the sensation of sand in the eye, to spasm of the lids, and equiphara.

Whenever ulceration is present on the cornea, recourse should be had to the solution of nitras argenti. A stronger solution than that of 4 grains to the ounce may be employed, and with a small camel's-hair pencil applied directly to the surface of the ulcer, without permitting the solution to spread over the rest of the eye.

Solid Caustic.—When an ulcer threatens to penetrate deep into the substance of the cornea, or when it has already perforated into the anterior chamber, it is proper to touch the ulcer; or, if there is prolapsus of the iris, the myocephalon, every second or third day, with a pencil of lunar caustic, filed to a sharp point.

Mydriatics.—Even when a portion of iris is involved in such an ulcer, the dilating power of the belladonna may be sufficient to free it, and thus to preserve the pupil entire. In cases of perforating ulcer near the edge of the cornea, we can have recourse to the use of belladonna with less confidence; for while the dilation cannot, in this case, be carried so far as to remove the iris from the vicinity of the ulcer, it is doubtful whether the state into which the iris is thrown is not apt to favor, rather than prevent, prolapsus. Belladonna is of great service in subduing the intolerance of light; indeed, it may be regarded as a specific for this distressing symptom. A good mode of applying it is to expose the eyes to a teaspoonful of its vinous solution, raised into vapor, by being added to a teacupful of boiling water. An ointment containing extract of belladonna, rubbed around the eye, is serviceable; as is also the collyrium of murias hydrargyria with vinum belladonna, already noticed. Similar benefit is to be derived from the salts of atropia, and from other mydriatics, besides belladonna; such as hyoscyamus and stramonium.

Relapses.—No disease is so apt to recur as ophthalmia. It is therefore necessary for children who once suffered from it, to be submitted, from time to time, to the inspection of their medical attendant, who must endeavor promptly to subdue every symptom of a reattack, and to conduct his patients safely through that period of life which is most exposed to the disease. In this way much mischief will easily be prevented, which, should the disease be neglected, may require years to remove, or prove altogether beyond remedy.

PUSTULAR OPHTHALMIA.

Although pustular ophthalmia may be found in persons in whom no strumous affection can be traced, yet it can hardly be considered anything more than a variety of the disease; however, the subjects of it, generally speaking, are those who pass the age of strumous ophthalmia, *viz.*:—persons from 12 to 25 or 30 years old.

It is not so dangerous a disease as strumous ophthalmia, neither is there the same intolerance of light; blepharospasmus is of very rare occurrence; and it is found to yield more readily to well-directed treatment.

Although the pustules vary in situation, yet they are always on the sclerotic, never on the cornea, but generally close and inferior to it. They also vary in size and number; are very little elevated, of a yellowish cast, although, when they burst, they discharge a fluid that is more of a watery than purulent character. The ulcer left by the bursting of a pustule generally forms a groove between the cornea and sclerotic; and although it does not spread, it will sometimes penetrate into the interior chamber of the eye, which may be followed by prolapsus of the iris.

Treatment.—The best treatment is that recommended for strumous ophthalmia. Unless an ulcer is formed, I have rarely found it necessary to use a stronger stimulant than from 5 to

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10 grains of nitrate of silver, twice a day; if it gives much pain, I generally drop on the conjunctiva 1 or 2 drops of 1 grain of morphine, to 1 ounce of rose-water; at bedtime I order yellow oxide of mercury 4 to 5 grains mixed up well with 1 ounce of glycerine ointment.

ERYSIPELATOUS OPHTHALMIA.

It frequently occurs that erysipelatous inflammation of the head and face extends to the conjunctiva, but idiopathic erysipelatous conjunctivitis is a disease very seldom met with; it does sometimes, however, take place, and may be produced by any of the causes which excite simple inflammation of the conjunctiva.

Why injury, cold, etc., will produce simple conjunctivitis in one person, and the erysipelatous in another, is not more easily explained, than that from the same causes simple inflammation will be produced in the integuments of one, and erysipelatous in another person.

All that can be said in explanation is, that there is some predisposing cause existing in some persons, that is not in others, when, if they only receive the slightest injury, erysipelatous inflammation is sure to follow.

Symptoms.—The symptoms of this disease are, an increased vascularity of the conjunctiva, but the color is of a much paler red than in any other form of inflammation. This vascularity is soon followed by watery infusion into the sub-conjunctival cellular tissue, causing the conjunctiva to become so elevated as to overlap the edge of the cornea, and even, sometimes, to protrude between the lids; this swelling resembles chemosis in every respect, except in not being so vascular. The pain is generally very slight, and of a prickly nature. Intolerance of light and lachrymation are seldom complained of, except when the disease is very severe, and even then these symptoms are not very bad.

The secretions from the conjunctiva and meibomian glands become increased, and altered in character, so that the lids are glued together when the patient awakes in the morning. If the case be mild, the conjunctiva, instead of swelling in the manner just described, merely forms yellowish vesicles around the edge of the cornea. When the disease goes on favorably the symptoms subside, the secretions of the eye gradually assume their natural appearance, the swelling abates, but for a long time the conjunctiva does not assume its natural color.

The local treatment must be particularly attended to.

As a general rule, the 10 grain solution of nitrate of silver will be a sufficiently strong stimulant, but when the inflammation is very severe, from 15 to 20 grain solution may be applied. The patient should bathe his eyes two or three times a day with the soothing lotion, or the 8 grain solution of alum, and smear the edges of the lids, at night, with some yellow oxide of mercury ointment, from 4 to 5 grains to the ounce of water.

When the conjunctiva is greatly swollen, benefit is derived from opening it either with a lancet or cataract knife. Some authors recommend depletion, but it is a treatment I should never think of adopting.

RHEUMATIC OPHTHALMIA.

It has been already stated that there are three ophthalmias frequently produced in adults from atmospheric influences, *viz.*: the catarrhal, the rheumatic, and the catarrho-rheumatic.

Diagnosis.—The following particulars will serve sufficiently to distinguish rheumatic from catarrhal ophthalmia:—

1st. *Seat of the Disease.*—The catarrhal ophthalmia is an affection of the conjunctiva; the rheumatic has its seat in the albuginea and sclerotica, and frequently extends, in some degree, to the iris, and even to the retina.

2d. *Redness.*—The redness in the catarrhal ophthalmia is reticular, and the turgid vessels are evidently conjunctival; in the rheumatic, the chief redness is radiated or zonular, and seated under the conjunctiva, or in the deep-seated conjunctival, or sclerotic, net-work. We never see spots of blood extravasated under the conjunctiva in rheumatic ophthalmia; whereas, this is a frequent occurrence in catarrhus oculi.

3d. *Nature of Inflammation.*—The catarrhal ophthalmia is an inflammation of a mucous membrane, and is a blennorrhœal or profluvial disease, attended with an increased and morbid secretion of mucus; the rheumatic attacks the fibrous membrane of the organ of vision, and is unattended by any morbid secretion from the surface of the eye.

4th. *Pain.*—The pain in the catarrhal ophthalmia arises on the surface of the conjunctiva, is compared to the sensation of roughness, or the feeling which might be excited by sand or broken glass under the eyelids, does not extend to the head, and is felt most in the morning, or when the eyes begin to be moved; the pain of the eyes in the rheumatic ophthalmia is pulsative and deep-seated; the chief pain, however, is not so much in the eyeball, as round the orbit, under the eyebrow, and in the temple, cheek, and side of the nose, and is severely aggravated from sunset till sunrise.

When I am asked, "What is meant by rheumatic ophthalmia?" I should answer to the following effect:—

1. By rheumatic ophthalmia, I mean simply inflammation of the fibrous membrane of the eye (the sclerotic), and of the adjacent parts of similar structure, excited by exposure to cold.

2. I do not regard this ophthalmia as an inflammation, differing in kind from common inflammation, in consequence of the existence of what has been called the rheumatic habit, or diathesis. The train of symptoms seems to depend, not on the constitution of the person, but on the structure and functions of the part affected.

3. Rheumatic subjects are by no means exempt from this ophthalmia; yet it frequently occurs in individuals who have never suffered from rheumatism in any other part of the body. We seldom see both eyes affected with rheumatic ophthalmia at once. When both are attacked, the one is always much more severely inflamed than the other.

Dimness of vision uniformly attends this ophthalmia, depending on an accompanying haziness of the cornea and pupil, attended by a slight contraction of the latter, and sluggishness in the movements of the iris. If only one eye is affected, which, at least for some time, is generally the case, the pupil of that eye is seen at once to be less than that of the sound eye.

The iris becomes slightly discolored: it becomes greenish, for instance, if naturally blue; and the attending iritis may proceed even to effusion of coagulable lymph within the pupil. It must be understood, however, that a severe degree of iritis rarely attends rheumatic ophthalmia. The access of light does not, in general, prove very distressing to the patient. The affected eye feels dry and hot in the early period of the disease; but after a time, especially when the symptoms are somewhat abated by blood-letting, there is considerable epiphora.

The pain which attends rheumatic ophthalmia at its commencement is of a stinging kind. The patient never fails, in the history he gives of his case, to insist on the nocturnal pain, and with his finger to point out its supra-ocular or circumorbital seat. It affects much more the forehead, temple, and side of the nose, than the eyeball. It is reasonable to conclude that, in this disease, the periosteum, in and around the orbit and the fascia of the temporal muscle, structures similar in nature to the sclerotica may also be affected with rheumatism. The chief seat of the pain, however, appears to be one or more of the six branches of the fifth nerve, which, radiating from the orbit, are distributed to the face; and we may fairly suppose a considerable portion of the pain to arise from the sympathy which these nerves have with those distributed to the interior of the eyeball, and which lie embedded on the inside of the sclerotica.

Constitutional Symptoms.—A considerable degree of symptomatic fever attends this disease, increasing along with the nocturnal paroxysms of pain. The pulse becomes frequent, and sometimes strong, full, and hard. The tongue is white and furred, and the mouth ill-tasted; there is more or less nausea, and the skin is hot and dry. The digestive organs are deranged, the appetite impaired, the bowels generally confined, and the excretions morbid.

Exciting Causes.—Rheumatic ophthalmia may be distinctly traced, in most instances, to exposure of the eye to a continued stream of cold air, while the head and face are in a state of perspiration.

The patient, in the history which he gives of his case, commonly mentions some particular exposure of this sort, soon after which the redness and rheumatic pain commence: for example, sleeping with the head exposed to the air entering by a chink in the wall, or by a broken pane of glass; travelling during the night in a carriage, with one side of the head close to a broken window; suddenly issuing from a crowded room into the cold air of the street; exposure to the current of air which flows from the stage into the body of a theatre; keeping wet cloths on the head when overheated; and the like.

I have not observed that this disease is much more apt to occur at one season of the year than another. It is certainly more prevalent when the wind is cold and north-easterly. It is much more apt to attack persons of middle age than either the young or old. Indeed, I have never seen it in children, nor in those far advanced in life. Probably the same exciting causes which, in persons of middle life and robust constitution, are apt to produce rheumatic ophthalmia, would in a child excite catarrhal or scrofulous ophthalmia, and in an old person the catarrho-rheumatic or arthritic. Rheumatic ophthalmia is very apt to reattack an individual who has previously suffered from it.

Prognosis.—If the disease is taken in time, the prognosis is favorable. Allowed to proceed in its course, the pupil may close, or the anterior crystalline capsule be left opaque.

Treatment.—Calomel and Opium.—I have never failed to find this combination highly useful in checking the circum-orbital pain, and dissipating the other symptoms. A pill, containing 4 grains of calomel with 1 grain of opium, is to be administered every evening, till the gums be affected, when the calomel may be omitted, and 10 grains of Dover's powder substituted for the opium. In some cases smaller but more frequent doses of calomel and opium may be proper, such as 2 grains of calomel with half a grain of opium thrice a day. Mr. Jones states that mercury, given in this disease so as to produce ptyalism, aggravates more than mitigates the symptoms. This does not correspond with what I have observed. I do not, indeed, push the mercury to make the mouth sore, but I have not witnessed any bad effects from the gums becoming affected.

Opiate Frictions.—The patient experiences great relief from carefully rubbing the forehead and temple with a piece of sponge for five minutes, with the concentrated tincture of capsicum, and mind and do not let it get into the eyes; if it gets into the eyes, it gives much pain, and does no good; or with warm laudanum, or extract of belladonna infused in laudanum. This ought to be done about an hour before the nocturnal paroxysm is expected, which it will greatly assuage, and sometimes entirely prevent. In chronic cases, equal parts of laudanum and tincture of cantharides form a useful liniment. Where there is morbid pain, I order half a dozen or a dozen leeches, to the forehead or temple. Blisters behind the ear, and to the temple, will be found useful.

Belladonna.—During the whole course of rheumatic ophthalmia, the pupil of the affected eye ought to be kept under the influence of belladonna, either by painting the moistened extract upon the eyebrow and eyelids morning and evening, but especially at bedtime, or by infusing 1 drachm of the extract in each ounce of the laudanum which is used for rubbing the head.

Purgatives.—A smart dose of laxative medicine ought to be administered at the commencement of treatment. Afterwards, a laxative clyster every morning, or a small dose of Epsom salts may be employed, to obviate the constipating effects of the opium. More powerful purgatives are now improper, as they would carry off the calomel and opium, and thereby prevent their good effects.

Sudorifics.—The warm pediluvium at bedtime, with diluent drinks towards evening, operating along with the opium, will, in general, excite a sufficient degree of diaphoresis. Mr. Wardrop recommends antimonial powder, and Beer employed guaiac, for exciting the skin in this disease.

Tonics.—Small doses of sulphate of quinia, or of the mineral acids, will be found advantageous in the chronic stage of the disease, and during convalescence. In old mistreated cases, Fowler's solution sometimes gives great relief, in doses of from 8 to 12 drops thrice a day.

Applications to the eye itself have but little power over this disease. Those which are so useful in other ophthalmia, are often hurtful in the rheumatic. The lunar-caustic solution, for instance, which may be regarded as a specific in catarrhal ophthalmia, is in the present disease decidedly injurious. When all the febrile and painful symptoms, however, are gone, and a little more than lingering redness, with weakness of the eye, remains, 2 grains of morphine to 1 ounce of rose-water, or 1 drachm of laudanum to 1 ounce of rose-water, will be found beneficial, dropped upon the eye twice or thrice, or the pure vinum opii, once, daily.

The first, second, third, and fifth of these remedies are to be had recourse to in the first instance. I have never found them fail in any acute case, however severe; nor have I witnessed any permanent sequelæ, when the plan of treatment now explained was adopted with the necessary vigor.

GONORRHŒAL OPHTHALMIA.

The affection, resulting from inoculation with gonorrhœal matter, is even more violent than idiopathic purulent conjunctivitis. It comes upon the eye with terrible suddenness, a few hours after infection, and the cornea may be totally destroyed and vision hopelessly lost in a few hours more. I have, myself, seen patients who had lost both eyes, from sloughing of the cornea, within less than 48 hours from the time of inoculation, which was distinctly traced; and instances are recorded, where even a less time has been sufficient for this irreparable mischief. It is more frequent in males than in females; the pestilent secretion being much more likely in them to be conveyed from the genitals to the fingers, and thence to the eyes. It is usually confined to one eye, at the very outset, and subsequently, unless the discharge from this is carelessly allowed to enter the other eye. The swelling of the conjunctiva, sub-conjunctival tissue, and all the textures of the lids, proceeds with great rapidity, the skin of the lids becoming livid from distension.

This is accompanied by a copious, thin secretion, of a straw color, or, sometimes, a slightly greenish tint. The chemosis is phlegmonous, and its effect on the vessels supplying the cornea, with the retention in contact with it of the morbid secretion, causes a loss of vitality in that tissue, showing itself in ulceration or in the formation of a slough, involving a part or the whole of its extent, and penetrating more or less deeply. In some instances, this process of disorganization occurs in the whole circumference of the cornea and thrown off in one mass. When ulceration or sloughing is taking place, we observe a dirty, sanious discharge mingled with the purulent conjunctival secretion.

Treatment.—Of the treatment of gonorrhœal ophthalmia, there is but little to add to that already said, under the head of purulent ophthalmia. There are just as many different modes recommended: those who advocate the antiphlogistic treatment and mercury, in the purulent, consider it necessary to push it even farther in the gonorrhœal; and those who recommend the stimulating local treatment in the former, advise the same in the latter.

For my part, I treat both diseases in the same way; but I consider that if mercury is of use in either form, it is in this, although I think its good effects appear, chiefly, after the inflammatory stage is over.

OPHTHALMIA FROM ERUPTIVE FEVERS.

By this term is meant such inflammations of the conjunctiva as are found accompanying, or the result of, scarlet fever, small-pox, measles, or erysipelas. The ophthalmia which accompanies scarlet fever and measles, is called ophthalmia scarlatinosa, and morbillosa; although the disease, in both cases, may be nothing more nor less than simple catarrhal ophthalmia, which very generally disappears as the fever gets well; but if it does not, it must be treated as simple inflammation of the conjunctiva, for, if allowed to go on, it will assume a chronic form, and is likely, after continuing for years, to terminate in an incurable ophthalmia tarsi.

When the inflammation assumes a chronic form, several vessels, of a bluish-red color, will be seen to traverse the white of the eye; the palpebral conjunctiva of the lower lid will be a dusky-red color; the lids will be glued together in the morning when the patient awakes; and, after some time, the sight becomes very weak, which is first discovered by the patient when reading by artificial light.

The treatment I find best for such cases is, to introduce between the lids, every night, a small portion of yellow oxide of mercury, four to five grains, mixed up well with one ounce of glycerine ointment, or, if the case is severe, Jannin's ophthalmic ointment, without dilution, and have the eyes bathed three or four times a day with the soothing lotion. The best constitutional treatment is, to give small doses of quinine and tartarized antimony. Any of these inflammations may become modified by a strumous diathesis; if so, it must then be treated on the principles laid down in strumous ophthalmia.

CHRONIC OPHTHALMIA.

This general term is made to comprehend several affections having but little real affinity with each other.

Catarrhal ophthalmia, which has passed into a chronic form, with or without a granular condition of the eyelids, an irritable state of the tarsal margins, or a slight degree of obstruction to the passage of tears into the sac, are all, occasionally, arranged under this rather vague heading. The chronic state into which the catarrhal ophthalmia, if not suitably treated during the acute stage, is so apt to pass, is characterized by a slight redness about the edges and corners of the lids, and a swollen condition of the caruncula and semilunar fold of the conjunctiva. When the lining membrane of the lids is examined, its vessels are found enlarged, and its surface, instead of being perfectly smooth, is slightly villous.

The patient complains of the eyes watering much when exposed to a cold wind. By candlelight (and still more by lamplight) they itch and prick, and the flame of a candle appears surrounded by a halo of prismatic colors, from the refraction caused by the thickened mucus on the surface of the cornea. The eyelashes are gummed together in the morning.

Tailors, needle-women, clerks, and all persons occupied in working upon small objects by artificial light, especially if in ill-ventilated rooms, are frequent subjects of this chronic ophthalmia. They are often unable to take precautions for modifying the irritating effects of the light they employ. When, however, they can do so, great relief may be obtained by the use of a pale-blue chimney or shade to the lamp or gas-jet.

Weak solutions of acetate of zinc, mur. of ammon., or alum, ten grains each to four ounces of water, wash the eyes every night and morning, and let it get into the eyes; yellow oxide of mercury used at bedtime, to prevent agglutination, are useful in the more irritable form of chronic ophthalmia.

In cases of a less active kind, unguent. hydrarg. nitratis, or unguent. zinci oxydi, diluted with fresh lard or spermaceti, may be substituted.

These applications should not be used for too long a time together; but should now and then be omitted for a week, and then resumed, if necessary.

Small blisters to the temples, or tincture of iodine to the eyelids, will often be found more serviceable than direct applications to the conjunctiva itself.

The surgeon must be careful to correct whatever may be faulty in the general health; and not to trust solely, or chiefly, to local means.

When watering of the eyes, on exposure to cold winds, is the symptom most complained of, the excretory lachrymal apparatus should be carefully examined. Pressure on the sac, made in a direction towards the puncta, will show whether the contents of the former consists of pure tears, or of a mucous and muco-purulent secretion. A probe of a suitable size should be very carefully passed through each punctum, as far as the sac, to ascertain whether the canaliculi are free from obstruction.

This important examination is very frequently neglected. I shall speak of it more fully when treating of the diseases of the Lachrymal Apparatus.

In all cases of tedious Chronic Ophthalmia, which cannot be traced either to previous catarrhal inflammation, or to obstruction in the lachrymal passages, the surgeon should most carefully scrutinize the edges of the tarsis, and observe whether some irregularly-growing eyelash may not be the cause of the irritation. A single fine hair, so delicate as to be perceptible only in a good light, and to a practised observer, is quite sufficient to cause great annoyance; and I have met with several cases where, for want of a thorough examination of this kind, patients have for months, or even years, tried in vain every form of ointment and lotion.

OPHTHALMIA VARIOLOSA.

This is not the disease arising from simple conjunctivitis accompanying small-pox; but it arises from an eruptic inflammation of the integuments, spreading to the conjunctiva, and producing similar pustules on the conjunctiva, to those first formed on the integuments.

Formerly, in consequence of the frequency of small-pox, many people lost their sight, by either partial or total staphyloma, as the result of this formidable disease. The pustules may form on any part of the conjunctiva, but they are generally found on the cornea. When they first appear, they form small white points, which gradually become yellow and elevated: these in time burst, leaving ulcers of a sloughy character, which often destroy the whole cornea, and frequently penetrate into the anterior chamber of the eye, producing a loss of the aqueous humor, and prolapsus of the iris. A very frequent result of this disease is ophthalmia tarsi, with obstruction of the nasal duct, which, as a matter of course, produces stillicidium lachrymarium.

From the commencement of ophthalmia variolosa, the lids are swollen with the inflammation and pustules; sometimes, indeed, so much so as to render it impossible to examine the cornea.

If the purulent matter is not kept washed off the lids, they will be adherent together; but the practitioner must bear in mind that though the lids be swollen and adherent together, yet the conjunctiva may be perfectly free from inflammation and pustules.

Authors have described secondary variolous ophthalmia, as occurring when the small-pox has either subsided, or entirely disappeared; it is said to be much less violent than when it occurs during the virulence of the disease, although it sometimes does go on to the destruction of the cornea; but that this rarely happens unless there is a high degree of secondary fever.

I have seen a case of secondary variolous ophthalmia, but I have seen the primary modified by a scrofulous diathesis.

Treatment.—If there were no pustules on the conjunctiva, I would treat the case as simple conjunctivitis; but if there were pustules, I would open them with a cataract needle, and afterwards touch them with the solid nitrate of silver once every day, as long as the ulcer continued to slough or spread; but when it ceased so to do, I would substitute the four or six grain solution of nitrate of silver to one ounce of rose-water.

During the disease the eyes should be kept perfectly clean, by means of a soft sponge and warm water; and the lids prevented from adhering together at night, by having them smeared at bedtime with some stimulating ointment, such as yellow oxide of mercury.

Some recommend blood-letting and general antiphlogistic treatment. I prefer the tonic plan, that is quinine, or the infusion of colomba acidulated with nitric acid. When variolous ophthalmia is modified by a strumous diathesis, I treat it on the same principle as strumous ophthalmia.

GRANULATED OPHTHALMIA.

Granular Inflammation, or Granulated Eyelids.

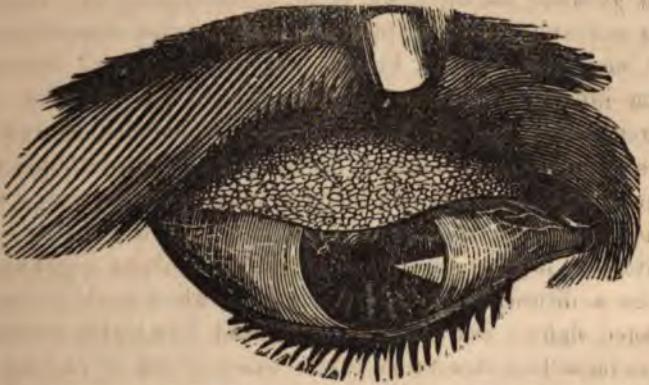

Fig. 12 represents a granular state of the conjunctiva of the upper lid, with the first effects of its pressure upon the globe; the inflammation occasioned by that pressure being indicated by the reddened appearance of the subjacent conjunctiva, and the haze of the upper part of the surface of the cornea.

This is one of the most frequent, and by far the most obstinate, of all the diseases to which the eye is subject. It is to be found in all places, and among all classes of people, and is very prevalent throughout the wide Western prairies. Thousands upon thousands are at this moment sufferers by this terrible destroyer of the human eye, and thousands are now groping their weary way in darkness, never again to behold the face of man, or to witness the rising or setting of a summer sun. This disease, which so effectually and certainly destroys the sight in the course of its natural career, may generally be recognized, after it has become fairly established, by the following appearances:—

It now and then happens, from continued or chronic inflammation, that the smooth surface of the conjunctive lining the lids is raised into lobes or granules, and at the same time preternaturally reddened. This state of granular conjunctiva is occasioned by chronic irregular thickening of the membrane, and organization of adhesive matter poured, by previous inflammatory action, into the cellular tissue beneath; the membrane itself remaining entire, without the slightest abrasion of surface.

A granular lid, therefore, is not a granulating lid: but granular is simply the term applied to that peculiar appearance on the surface, produced by unequal and unnatural distension from inflammatory effusion in subjacent parts. The term "granulating" would of course imply a denuded or raw surface secreting granulations. The granular projections, when first formed, are soft, and bleed readily under pressure; when of long standing they become firm, hard, and less vascular.

Now, as it affects the lids only, this complaint might appear to be a disorder of trivial importance, which could never endanger sight. But a most severe and formidable disease, in more important structures, is the consequence of its long continuance; hence, a knowledge of the proper treatment is essential.

The part which suffers first from the effects of granular lids is the transparent cornea. This tunic, from the constant friction of the irregular surface, becomes inflamed, opaque, and vascular; and if the source of irritation is allowed to continue, it becomes abraded and disorganized, and thus total destruction of vision is the ultimate result.

A nebulous or diseased cornea, then, is a frequent consequence of granular lids; and a neglected case of this kind occasionally terminates in blindness. Now, the effects of the pressure of granular lids on the transparent cornea are sometimes erroneously attributed to other causes; and, therefore, lest you should fall into this error, I advise you, in all cases of diseased cornea, to pay particular attention to the condition of the palpebral conjunctiva, especially that of the upper lid.

For the peculiar disease of the transparent tunic first shows itself on the upper part of the cornea to which the upper lid corresponds: a plexus of red conjunctival vessels, passing down from the circumference of the globe, overshooting the margin of the cornea, and sending extremely minute branches to vesicles which form on that tunic, rapidly burst, and leave a scabrous appearance behind. After a very short time a haze appears: showing that the inflammation on the surface of the cornea is extending to its deeper layers: a more opaque haze succeeds and spreads widely, the greatest degree of opacity still residing in the upper part. The whole cornea eventually becomes uniformly opaque and white, and surrounding structures partake in the morbid action.

Remember, then, that in all cases of granular lids, you have to look for the worst effects of the disease on the upper part of the transparent cornea; and again, in every case of superficial inflammation of the cornea, if the appearances I have described are met with, you may rest assured that they owe their existence to the mechanical pressure of the eyelid.

The vision is generally somewhat impaired. Cloudy vision is a very common symptom, especially in the morning. Besides, the eyes are very irritable. They are very sensitive to every external injury, especially to smoke, dust, wind, impure air, bright light. They will bear no kind of straining, reading, writing, or any kind of fine work; artificial illumination, particularly, excites the most unpleasant sensations, causes a marked increase of the hyperæmia and secretion, and even favors the proliferation of tissue.

The cloudiness of vision depends, on the one hand, on the mucous secretion of the conjunctiva, and, on the other, on the thickening of the epithelial layer of the cornea. The latter appears, again, to be dependent, in part, on increased formation, partly on decreased throwing off of the epithelium as a result of the limitation of the movements of the lids.

Prognosis.—Although by sufficient clothing, proper diet, restraint from intemperance, good air, and judicious medical treatment, the sarcomatous state of the lids and opacity of the cornea may, in general, be lessened or removed, and vision restored; yet, if the patient be of intemperate habits; be ill-fed, or be insufficiently protected from cold winds, or damp cold weather, relapses will almost certainly take place, attended by renewed inflammation of the conjunctiva and puriform discharge; so that at last, especially in scrofulous subjects, the disease may prove incurable. Attempts to hurry the cure, by the too liberal use of local means, often throw the disease back, and bring on the phlyctenulæ on the cornea; and I order my patients to wear large London-smoked spectacles; they keep the eye from the glare of the sun, and dust, and keep the eyes from a relapse.

The granulations of species are probably always the result of the contact of some organic substance with the ocular conjunctiva. Among such, discharges from the vagina, or from a granular conjunctiva, are the most usual. The use of the same water, towels, etc., for washing, is a frequent cause of the ophthalmia spreading in schools, barracks, etc.

Towels, lint, sponges, etc., used by patients who suffer from granulations, must not be used by any one else. The hands must be washed after touched eyes so affected. The authorities of schools, barracks, etc., should be informed of the contagious nature of the "ophthalmia." Those suffering from it, while under treatment, should be kept separate from others.

Treatment.—Before I give the opinion of others, I shall describe, in as short a space as possible, the local treatment adopted by myself in such cases. When met with in the early stage, I first cleanse the eyes with a sponge and warm water; then, if possible, evert the lids one after the other, beginning with the upper. I next sponge and dry the palpebral conjunctiva, then brush every part of it over up to the line of reflection, with a camel's-hair pencil previously wetted with from 5 to 10 grains to the ounce of water, of nitrate of silver, till the granulation become quite white; after which I take another camel's-hair pencil and pass over a little salt and water.

During the above treatment I keep the upper part of the orbit, and behind the ears, painted with tincture of iodine. If this treatment does not go on well, I change it for sulphate of copper, from 15 to 20 grains to the ounce of distilled water, and 2 grains of morphine; and at bedtime I order him to smear the eyelids with yellow oxide of mercury ointment.

If the lids are much swollen and tense, and seem to press upon the cornea, an incision about half an inch in length is carried through the outer canthus. The wound is allowed to bleed freely, and prevented from closing for a week, by passing a probe into it.

The discharge during acute attacks of granular ophthalmia is profuse, watery, and mixed with some mucus or pus; in some cases it is muco-purulent and abundant, as in catarrhal ophthalmia. During the chronic stage it varies; there may be none. The lids are slightly "gummed up" in the morning, and some mucus may hang about the eyelashes and canthi during the day.

In acute cases I order an astringent wash of acetate of zinc, mur. ammon., and pulv. alum, 15 to 20 grains each, to the pint of water; wash the eyes two or three times a day, and let it get into the eye.

One ounce of glycerine and 1 drachm of tannin, mixed together, is found to be an excellent remedy for granulations.

Astringents.—Many different substances of this class, the local action of which on the animal tissues depends on their affinity for albumen and fibrin, have been employed in the treatment of granular conjunctiva, the chief being alum, borax, sulphate of zinc, and acetate of lead.

The French and German oculists highly recommend the medicated stick: 1 part of nitrate of silver, and 2 parts nitrate of potash. It is also used in the New York Eye Infirmary.

Crayon: 4 parts sulphate of copper, and 1 part sulphate of morphine, is found to be an excellent remedy for granulations.

Dr. Underwood, also Dr. H. Ralls Smith, both of Chicago, highly recommend the chloride of gold in acute and chronic inflammation of the eyes. It may be used from 1 to 5 grains to the ounce of distilled water, applied to the everted lids once or twice a day, according to the nature of the case.

Dr. Charles Bader, Ophthalmic Assistant-Surgeon at Guy's Hospital, London, highly recommends green stone for granulations. "Green Stone." (*Lapis Divinus.*)—℞. Cupri sulphatis, nitri puri, aluminis, āā ℥j., camphoræ rasæ, ʒss. These ingredients to be moulded into sticks, and used for "touching" the conjunctiva when granular.

Granulations are generally treated with caustics. Those commonly used, are the sulphate of copper ("blue stone"); a mixture of the latter with alum, etc. ("green stone," or *lapis divinus*); the nitrate of silver; the crystallized nitrate of silver (1 part), saltpetre (2 parts), melted into sticks, and, for protection, covered with gauze and collodion; and the powdered acetate of lead (used in chronic granular ophthalmia). The latter, when sprinkled upon the conjunctiva, remains between the granulations, causes the surface of the conjunctiva to become more uniform, and contributes towards the shrinking of the granulations.

The guttæ cupri sulphatis (grs. xj. ad aquæ ℥j.), are frequently prescribed; also the lotio plumbi acetatis (grs. x. ad aquæ ℥j). The unguentum cupri sulphatis, made with glycerine, may be found of use.

Mr. Lawrence recommends the liquor aluminus compositus, which, at first, is to be used in a diluted state. Each fluid ounce of this preparation contains about 8 grains of alum, and as many of sulphate of zinc. The method of applying this and similar astringents in the fluid form, is to pencil them on the diseased membrane with a camel's-hair brush.

M. Chassignac used a crayon of borax, or sulphate of zinc. The borax he employs in its native state, only cut into the form of a cylinder. As it is but little soluble, he leaves it in contact with the conjunctiva for a few moments, and it has the effect of slightly whitening the surface without producing any scar.

Sulphate of zinc he employs also in the form of a crayon, but mixed with variable proportions of powdered gum Arabic.

A paste being made of the two substances, it is rolled into the shape of a crayon, to be applied in the same way as the borax.

M. Buys introduced the neutral acetate or sugar of lead, in the state of an impalpable powder, applying it over the diseased surface with a miniature pencil, allowing it to dissolve in the tears. The immediate effect is to cause strong contraction of the diseased tissue; the granular prominences shrink; and the membrane appears smooth and uniform. After replacing the eyelid, the salt assumes a white, shining appearance, and it is often a very long time before it becomes detached. It is to be applied at intervals of five or six days, till the cure is accomplished. It is stated that in this mode of treating granular conjunctiva, no insoluble precipitation is met with, even in cases where ulcers exist on the cornea, which is scarcely credible.

[An astringent wash of sulphate of zinc and common table-salt, in rose-water, of the strength of 10 or 12 grains of each salt to the ounce, will be found to be an excellent application in the management of granular conjunctiva, in connection with its treatment by escharotics.—H.]

Escharotics.—The escharotics most frequently used, have been nitrate of silver and sulphate of copper. A day or two after leeching or scarification, the lids being everted and dried from the gleety mucus with which they may be covered, the lunar caustic pencil is to be brought into a single rapid contact with the granular prominences. Before allowing the lids to be replaced, a little warm water is to be squirted over the surface which has been touched with the caustic, and after which a little castor oil is found very serviceable, as it relaxes the cornea. It is advantageous, after a time, to change the lunar caustic for the sulphate of copper, which may be more liberally applied to the diseased surface; and a smooth wedge of it pushed up occasionally behind the everted tarsus into the upper sinus of the conjunctiva.

A very convenient method of applying the sulphate of copper, and which will sometimes prove to be the only one available, as in cases of chronic ophthalmia attended with great tension of the orbicularis, softening of the tarsal cartilage, or disease of the ciliary follicles, precluding the possibility of eversion of the lid, is that recommended by Mr. Wilde. It consists in, first of all, slightly lifting the lid (the upper lid) off the globe, by drawing the integument upwards against the brow, in the usual manner, and then the piece of blue stone may be inserted underneath the lid, towards the internal side, as far up as possible, and held a little out from the eye, so that it does not touch the surface of the ball. It is then to be drawn downwards and outwards towards the external angle. This way of using the sulphate of copper we have often found very convenient. Caution should always be observed in drawing it from the one canthus to the other, so as not to allow the surface of the copper opposite to that which is in contact with the lid to touch the cornea, for, should it do so, an abrasion of its epithelial covering would be produced, and more or less opacity of its substance ensue. This can readily be avoided by drawing the crayon towards you, so as to make the lid stretch itself over it as you pass it downwards and outwards to the external angle.

The crayon of blue stone requires some care in its preparation. A large and perfect crystal of the salt should be selected. This is to be filed and rubbed down to about the size and form, as Mr. Wilde describes it, of the spade of cards, and of about the eighth of an inch in thickness at its shank, which is to be securely fastened in a quill or porte crayon. The whole of the crayon, thus prepared, should be kept always smooth and even, by frequently rubbing the surfaces and edges on a wet cloth. This, we believe, to be the proper condition in which sulphate of copper should be applied for granular disease of the lids.

M. Desmarres uses quite a rough, crude crystal of the salt, and thinks that advantage is to be derived from the additional irritation produced by its application in such a condition. But we feel satisfied, after having carefully watched its effects in M. Desmarres' own hands, at his clinique, and after having given it a full trial at Wills' Hospital, that such is not the result of its application in this manner. On the contrary, we feel assured that, in the majority of cases at least, the irritation will only impede the salutary effect of the escharotics, and, not unfrequently, serve to keep up the diseased action in the part.

Alternately, every two or three days, local depletion, and one or other of the escharotics, is to be employed; while warm fomentations, as the bichloride of mercury collyrium, are to be used thrice daily, and the yellow oxide of mercury ointment, or glycerine and castor-oil, equal parts, applied to the edges of the eyelids at bedtime. Besides lunar caustic and sulphate of copper, in the solid state, the application of these substances, and of other escharotics and stimulants, to the granular surface, in solution or in ointment, is useful; and especially yellow oxide of mercury, or a weak solution of sulphate of copper and morpine.

These assist in clearing the cornea, as well as repressing the sarcomatous state of the conjunctiva. A proper remedy, which I have known do good, is castor oil. Under this head may be mentioned the plan of pencilling the external surface of the lids, every second day, with Dr. J. B. Walker's crayon.*

Sorbefacients.—Much advantage is obtained, in many cases of granular conjunctiva, by putting the patient on the external use of iodide of potassium.

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* Dr. Walker has, for many years, made use of a crayon, composed of pure sulphate of copper and morphine. The lid being thoroughly everted, the discharge and moisture is to be removed, and the crayon applied every night, or every second night, according to indications. He also uses, in the same manner, a crayon of borax, and another of sulphate of cadmium.

These remedies, as well as all other medicines and appliances required in ophthalmic practice, and recommended by the author of this work, may be obtained at the North-western Medical Agency, 82 Madison Street, Chicago.

Dr. Walker insists on the importance of improving the patient's general health, by the administration of iron and quinine, singly or in combination, and regulating his diet.

R. Solution Iodide of Lime, with Protoxide of Iron, Tilden's, oz. viij.
A teaspoonful to be taken three times a day. J. B. W.

Ferri et quiniæ citras, dr. iss; ammon. carb., dr. ij; tinct. aurantii, oz. ij; aquæ destillat., oz. ij. Mix. A teaspoonful to be taken at 10 and 4 o'clock daily, in a little water. J. B. W.

He also recommends the Turkish bath.

Dr. Dixon, of London, speaks of the liquor potassæ as exerting almost a specific influence on palpebral granulations. The fluid is dabbed over the everted lids, so as to be thoroughly brought into contact with the whole surface, and it appears to act by saponifying and dissolving away the hypertrophied tissue. It may be applied at intervals of a few days, mild collyria being used in the interval.

Rubbing the external surface of the lids, for some minutes night and morning, with mercurial ointment, or with yellow oxide of mercury ointment, is found useful, in reducing the hypertrophy of the diseased tissue.

Excision.—When granular conjunctiva has proceeded to a great degree of exuberance, and continued for perhaps many months, notwithstanding a careful trial of other plans of treatment, recourse may be had to a more speedy method of removal, namely, by the knife. The eyelid to be operated on is to be everted as completely as possible, and the hypertrophial papillæ, at least the most prominent of them, shaved off by means of a small and very sharp lancet-sharped knife, or dissected away with the scissors.

In performing the operation, it is necessary to beware of removing more than the mere granular layer. If more than this is taken away, hard and irregular cicatrices are left on the internal surface of the lids, the effects of which on the cornea may be scarcely, if at all, less prejudicial than those of the morbid structure which has been removed.

CORNEITIS (KERATITIS; INFLAMMATION OF THE CORNEA).

SYPHILITIC CORNEITIS (*Scrofulous, Strumous Corneitis; Strumous Ophthalmia; Aquo-capsulitis; Corneitis punctata*).

This form of corneitis rarely occurs in infants, or in very young children, or in persons advanced in age; but most frequently between the ages of 9 and 15; and in girls oftener than boys. It appears, as a rule, in connection with syphilitic changes in other parts, and is the result of inherited syphilis. On inquiry, we often find that the mother of the patient had miscarriages or stillborn children previous to the birth of the one suffering from corneitis; also, that the patient has suffered from other symptoms of syphilis during infancy: as prolonged snuffles, a sore mouth, ulcers round the anus, various skin eruptions, etc. Hydrocephalus, of different degrees, discharge from the ears, and deafness, are common complications.

The physiognomy of these patients is very characteristic, and, when once recognized, cannot readily be overlooked. Its peculiarities are: a generally old, pale-looking face, a squarish forehead, with the bridge of the nose frequently wide and depressed, which, in most cases, is the result of anomalous development of these parts; in a few, the effect of loss of bone from caries. Cicatrices of former fissures in the skin round the lips, especially about the angles of the mouth, are met with, and there is a peculiarity in the shape, size, color, and number of the permanent incisor teeth, especially of the upper central ones. These teeth are small, narrow, squared, sometimes of a yellowish color, and, as a rule, more or less deeply notched in a vertical direction. The corneitis generally appears in both eyes, though seldom simultaneously; a few days or weeks (rarely more than a year) pass, before the fellow-eye is attacked. The left eye frequently suffers first.

Recurrent attacks, though rare, have been observed in both eyes, sometimes repeatedly. The corneitis may take a chronic cause, and continue for several years; the cornea may become completely opaque or crimson red, yet again recover its transparency after a few weeks. Patients generally seek advice on account of the impairment of sight. Vision for a time may be reduced to mere perception of light, from the corneal changes alone. It frequently remains permanently impaired, through changes in the other tunics. The degree of impairment varies during the different stages of the inflammation. The patient, if able to read, holds the type very close. Vision may remain permanently impaired from one or several of the following causes: Opacities in the cornea, alterations of its curvature, opacities in the crystalline lens, changes following choroido-retinitis, inflammation of the optic nerve, or cerebral changes, as hydrocephalus, etc. The ocular changes, though varying in degree, occur as a rule in both eyes, but are often more severe in the left; vision may remain useful during the prime of life, but fail prematurely. Patients are often much distressed by the different (dazzling) of light, caused by its transmission through semi-transparent portions of the cornea. A profuse flow of tears, intolerance of light, slight swelling or spasmodic closure of the lids, are sometimes present, but may be entirely absent, or may appear or disappear during different stages of the corneitis. They are usually caused by changes on the surface of the cornea, *e.g.*, vesicular or nodular elevations.

As a rule, there is no pain, or hardly any complained of, in the eye, while there is sclerotic or conjunctival redness. Sometimes, however, very severe pain occurs during the process of cicatrization, if the ciliary region has been implicated, or if choroiditis round the optic disc has accompanied the corneitis. The vascularity of the ocular conjunctiva is, in many cases, but slightly increased, while a more or less broad, pink zone in the sclerotic, along the margin of the cornea, is usually present.

Course.—The cornea at first loses its transparency more or less, especially in the centre and lower half. Frequently, small, ill-defined, gray, yellowish or brownish, and opaque dots, in groups or singly, appear in its lamellated structure; more frequently at or near the posterior elastic lamina, about the middle or lower part. This appearance, if combined with slight iritis, is described by some as "Aquo-capsulitis." It may be absent, or the patient may present himself after it has passed away. The surface of the cornea often appears dull or slightly uneven, as if pricked with a pin in numerous places.

In rare cases, small flaccid vesicles or pustules appear upon it, usually along its upper margin. These are situated immediately beneath the anterior elastic lamina. Within a few weeks the entire cornea may have lost its transparency, assuming a ground-glass color, some portions (the most depending) being more densely opaque, or appearing pink or crimson. The red color is most intense at the surface and periphery of the cornea, and is caused by bloodvessels passing from the substance of the sclerotic between the lamellæ of the cornea. These vessels are placed close together, and run somewhat parallel.

In severe attacks, or in patients of feeble health, lymph is abundantly developed in the cornea and iris, the former assuming a yellow and opaque color. Swelling of the iris and cornea, and their adhesion to each other, are followed by dense and permanent opacities, occupying, most frequently, the lower half of the cornea.

The cornea rarely regains its transparency throughout; changes in its curvature and faint opacities remain for life, particularly if the ciliary processes have been much implicated.

Though the cornea be the part most conspicuously altered, we find, as a rule, the other tunics simultaneously inflamed. The surface of the iris, after the corneitis has subsided, presents, in most cases, a characteristic and permanent steel-gray hue. Posterior synechiæ or irregularities of the pupil often become visible after instillation of atropia. With the ophthalmoscope, we frequently discover changes in the transparency of the lens; its nucleus becomes prematurely large, yellowish, and strongly light-reflecting. Dotted opacities occur on its surface, beneath the capsule. Changes in the vitreous chamber, with or without opaque shreds floating and gravitating in it; chronic suppuration of the choroid and vitreous substance, with subsequent softening and shrinking of the eye, and consequent loss of sight, are not infrequent occurrences.

These lesions have been observed in both eyes of the same patient. [See, also, Syphilitic Changes in the Deeper Parts of the Eye.]

Treatment.—In the treatment of this disease, much depends upon the state of the constitution; if the patient be of a full, strong, healthy habit, bleeding, with other antiphlogistic means, will be found serviceable, particularly if the acute stage be very severe. However, such cases are of rare occurrence; indeed, generally speaking, such are the subjects in which corneitis is found, that much more harm than good would be experienced from bleeding.

As long as active inflammation (deep-seated or superficial) is going on, the treatment is directed against the syphilitic diathesis. Frictions with mercurial ointment are employed. Unguent. hydrarg. nitratis mitius, "the size of a small pea," is ordered to be rubbed over the eyebrows at bedtime, and the internal use of iodide of potassium with sarsaparilla are prescribed. Some patients, however, are so weak, that good nourishment is the only thing that could be ordered for some time. In such cases, the formation of pus or lymph is particularly abundant. Locally, we use atropia, a few drops to be applied to the conjunctiva of the lower lid with a camel's-hair brush, from three to six times daily, as long as the tunics are unduly vascular; and three times weekly for one or two months after all vascularity has subsided.

Slight purulent or catarrhal ophthalmia seems to hasten the course of the corneitis considerably, and the applications of warm fomentations over the closed lids, every quarter of an hour during the day, and a linseed-meal poultice at night, should be tried in all cases, as long as the cornea appears vascular. These local means also favor the rapid development of blood-vessels in the cornea, in which the lymph tends to change into pus, and thus prevents perforation, etc. Some advise, for the same purpose, the local application of the oleum terebinthinæ.

Slight pressure, by means of lint and cotton-wool tied over the closed lids, materially assists in the preservation of the natural curvature of the cornea, and of the shape of the eyeball; and should be kept up until all undue vascularity has subsided. Opacities of the cornea occur frequently, after all inflammation has ceased, in spite of appropriate treatment.

The patients, or parents, must be informed of the often very slow course of the disease, which may extend over months; and of the frequently permanent impairment of vision, with opacities of the cornea, etc., which often ensue.

STRUMOUS CORNEITIS. (VASCULAR CORNEITIS; STRUMOUS OR SCROFULOUS OPHTHALMIA.)

This form of corneitis has been observed at all ages, but most commonly in scrofulous children, and in females shortly before, or about the age of, puberty.

Injuries of different kinds, foreign bodies upon the cornea, inverted eyelashes, also pustular ophthalmia, may, in weakly persons, give rise to it. Vascular corneitis accompanies the different forms of suppuration of the cornea (in which cases its appearance is a favorable symptom); it is also present during the healing of ulcerations. The absence of nodulous infiltrations distinguishes it from pustular corneitis.

The patient suffers from "pain in the inflamed eye;" this, sometimes, is severe, and extends over the corresponding side of the head and face. The lids are generally red along the margins, slightly swollen, and spasmodically closed, and there is abundant flow of tears, with more or less intolerance of light.

These symptoms, coupled with the presence of one or several small, ill-defined opacities in the cornea, are characteristic, provided there be no changes in the conjunctiva, as granulations, which may give rise to similar symptoms. Opaque and slightly vascular (inflamed) spots appear, in many cases, at the onset of the attack, at or near the centre of the cornea; in some, these spots seem to advance from the margin towards the centre. They are superficial; they rarely extend into the deeper parts. In weak persons, the entire thickness of the cornea may be implicated. The inflamed portions, which appear gray, grayish-white, or yellowish and opaque, shade off into the transparent cornea, or merge into the sclerotic. The vascularity of the sclerotic and conjunctiva is most marked next the inflamed part; a varying number of vessels pass towards or into the opacity.

Ulceration or suppuration of the inflamed portion, with perforation and hypopion, or iritis, may occur if the patient be weak, or the corneitis wrongly treated. The cessation of intolerance of light and of the flow of tears are sure signs of improvement. The bloodvessels and the redness and swelling of the lids then gradually disappear; the opacities fade away, and the cornea becomes again transparent. Semi-transparent opacities disappear in from three to nine months, but dense white or gray opacities may remain for life.

A peculiar form of vascular corneitis, accompanied by pain, intolerance of light, and lachrymation, is sometimes observed, most particularly in young females. Its symptoms are: a dense vascular web, resembling pannus, and generally appearing first like the latter along the upper margin of the cornea, but distinguished from it by the absence of "granulations in the conjunctiva." This form is probably of syphilitic origin. It readily subsides after a blister to the temples, small doses of bichloride of mercury being at the same time prescribed. I place in the very first rank, iodide of lime with protoxide of iron. Dose: For children, half a teaspoonful three times a day; for adults, a teaspoonful twice or three times a day.

Treatment.—The intolerance of light and the spasmodic closure of the eyelids are the most troublesome symptoms of strumous corneitis. The former is caused by uneven and opaque portions of the cornea; the latter is a reflex action, but may lead to a spasmodic condition of the orbicularis muscles, which persists after the changes in the cornea have subsided.

Blisters behind the ears, and tincture of iodine upon the temples, hardly ever fail to remove the intolerance of light.

Excision of a small portion of the supraorbital nerve, or division of the nerve, where it passes around the margin of the orbit, has been recommended by some.

In adults, if there be much pain or "redness," a few leeches to the temple may be tried.

The pain and intolerance of light may also be relieved by frequently fomenting the eyelids with lint dipped into warm water, and by the application of olive oil containing some chloroform or morphia to the skin around the eyes. In all cases, we order a few drops of atropia to be applied to the conjunctiva once daily, and the eyelids to be bathed occasionally with warm poppy-head lotion. The inflamed eye, or the one which is more inflamed if both are affected, is kept bound up until all redness has subsided.

If there is any purulent discharge, with or without an eczematous condition of the skin at or near the margins of the eyelids, or if the latter stick together after sleep, the patient is ordered to bathe the eczematous parts twice daily with alum and mur. ammon. (equal parts) lotion, and, after having dried them well, to rub in some yellow oxide of mercury ointment. The ointment should be washed off with warm water, and alum mur. ammon. used before applying fresh ointment. This, if repeated morning and night, succeeds in removing the eczema in from three to ten days, as a rule, and thus get rid of a great source of irritation.

In making use of medical treatment, we must be guided by the state of the patient's general health. Plain diet and cleanliness are essential. Children or adults, with a swollen or eczematous condition of the nostrils, are much benefited by the internal use of arsenic combined with steel. The fact that blisters remove, within the shortest time, the troublesome symptoms of most cases of vascular corneitis, provided the cause (granulations, cicatrices, etc.) be not seated in the conjunctiva of the lids, must not be lost sight of when considering the effects of internal remedies.

If ulceration or suppuration of the cornea complicate the case, we must be guarded in our prognosis; and the patient or the parents should be informed that a "speck" will remain on the eye for a long time, perhaps for life.

PUSTULAR CORNEITIS.

(*Phlyctenular, Strumous Corneitis; Herpes Cornea; Pustular or Strumous Ophthalmia.*)

Pustular corneitis, like the foregoing form, occurs most frequently in young persons and children. Extreme intolerance of light, continuing sometimes for months, slight redness, swelling and spasmodic closure of the eyelids, an abundant flow of tears, and frequent eczema of the surrounding skin, often with comparatively but slight changes in the cornea, are the usual symptoms.

As the pathognomonic sign, we observe one or several roundish, small, somewhat projecting, opaque nodules in the superficial layers of the cornea, standing alone or in groups, or in a row at or near the margin of the cornea. One nodule, or a small group of nodules, may appear at the apex of a bundle of bloodvessels, which latter diverge over the cornea, forming a vascular triangle, and ultimately lose themselves in the adjoining conjunctiva. The nodules often appear in the conjunctiva first (pustular ophthalmia), or are preceded by attacks of ophthalmia with sclerotic vascularity and intolerance of light. Nodules, pustules, patches of vascular corneitis, small ulcerations and opacities may be found together.

In rare cases, the entire surface of the cornea and conjunctiva is covered with vascular cicatrices, intermingled with pustules and nodules in different stages of development. At an early stage we may find the corneal epithelium raised at the apex of the nodule, causing a resemblance to a pustule. The nodule, or a part of it, may either undergo suppuration, sometimes in a few hours, or change into an ulcer, which, by its extension, may lead to perforation of the cornea.

The changes of nodules are preceded and accompanied by the above-mentioned symptoms, by inflammation of the surrounding cornea, and by a varying amount of vascularity of the sclerotic and conjunctiva.

The duration of these cases varies much. Some patients recover in a week, others only after months. The number of successive nodules, the time required for repair of the lesions of the cornea, the complications with higher degrees of corneitis, and, in a few cases, with iritis, are some of the causes of its prolonged duration. The cessation of intolerance of light is always a sign of a favorable turn of the disease. The corneitis may return for several years at about the same season, or at any time when the general health is impaired.

Whether the affected portion of the cornea ultimately becomes transparent, or remains more or less opaque, depends on the size, changes, and number of the nodules. One, or several, dull or chalky-white and opaque spots, shading off into the surrounding cornea, sometimes of the peculiar triangle shape mentioned above, may permanently remain.

Causes.—Pustular corneitis is most common in what are termed strumous persons. It frequently occurs after scarlatina, measles, and variola. It is most obstinate in persons suffering from acne rosacea, and from herpes of the mucous membrane of the nose. It is attributed by some to deranged function of the fifth nerve.

Treatment.—The general medical treatment varies, according to the state of health. In children, particularly, we order plain, regular diet, with some wine, and a warm bath every day. If the lips and nostrils are swollen and red, with crusts around the nasal orifices, Tilden places in the very first rank a solution of iodide of lime with protoxide of iron. Dose: in children, half a teaspoonful three times a day, and to adults, a teaspoonful two or three times a day.

Mr. Bader recommends arsenic and steel. If the sclerotic is implicated (much swollen and vascular), the bichloride of mercury is prescribed. In adults, the dose is one-sixteenth of a grain in half an ounce of water, twice daily.

In young children, the exhibition of hydrarg. c. creta will be found of use at the commencement.

The general medical treatment is continued for two or three weeks after all intolerance of light has subsided.

Local Treatment.—Adults should wear London-smoked spectadles, while at the same time the more inflamed eye is kept bound up. In children, both eyes, if severely inflamed, must be kept closed for one or two weeks. Touching the vesicle at the apex of the nodule with the solid nitrate of silver may arrest the inflammation at once; but we rarely see the case at this early stage. If the vascularity, pain, and sensation of heat are great, one or two leeches should, in grown persons, be applied at bedtime to the corresponding temple.

In all cases we prescribe atropia, to be applied once daily, with a camel's-hair brush, to the conjunctiva of the lower lid of the inflamed eye. The intolerance of light, if the lids cannot be kept bound up, is relieved by the application of the tincture of iodine, twice a week, to the skin of the lids. If the vascularity of the conjunctiva or cornea is considerable, but the intolerance of light and the flow of tears moderate or absent, calomel powder, applied twice daily to the cornea, until all vascularity has disappeared, has been found of use. Lotio aluminis is ordered, to wash the margins of the eyelids carefully, morning and night, if they are at all gummed up. The lotion is discontinued as soon as this has subsided. If the discharge is only watery, we order the lids to be kept clean with warm water, or with lotio papaveris.

The skin of the lids, if excoriated, should be washed twice daily with warm water or warm lotio aluminis, well dried, and then some yellow oxide of mercury ointment should be rubbed upon the excoriated portion.

The eyes should not be used for near work as long as there is increased vascularity, with intolerance of light; and the patient must be informed of the liability to fresh attacks.

PANNUS. (VASCULAR CORNEA.)

Pannus is a term applied to a vascular condition of the surface of the cornea. Pannus appears, as a rule, first along the upper margin of the cornea, where bloodvessels encroach upon its surface from the surrounding conjunctiva and subconjunctival tissue. Pannus often accompanies morbid changes of the conjunctiva of the eyelids, especially granular ophthalmia. Attacks of corneitis, of ulceration, suppuration, softening, etc., of the cornea, may appear as complications of the pannus. The term xerophthalmos is applied to the species of pannus in which a dry, gray, and opaque cuticle, continuous with the conjunctiva, covers the surface of the cornea.

Treatment.—For treatment of pannus with granulations in the conjunctiva, see Granular Ophthalmia.

Pannus caused by contraction or distortion of the tarsi, with contraction of the palpebral aperture, often disappears after enlargement of that aperture by operation. Pannus caused by cicatrices in the tarsus is much relieved by the excision of a portion of tarsus which includes the cicatrix. If the cause of pannus is removed, and the latter slight, occupying, for example, only the upper third of the cornea, no further remedies need be applied; but if it is considerable, so as to hide the pupil from view, and if there is no pain or increased heat, or undue watering of the eyes, benefit is derived from the application of a solution of nitrate of silver (grs. x., ad aqua ℥j.), with a camel's-hair brush, to the surface of the pannus every other day; and by touching any granulations, which may be present in the pannus, with a crayon of sulphate of copper and morphine. The operation of syndectomy is recommended by some, and by others the treatment of inoculation.

CORNEITIS WITH SUPPURATION.

(*Abscess in the Cornea; Suppuration of the Cornea.*)

A yellow-white, or yellow and opaque, discoloration of the cornea, when it appears in the course of corneitis, or of ulcer of the cornea, generally, indicates the presence of pus.

The pus may accumulate between the lamellæ of the cornea, layers of pus alternating with lamellæ, and thus no pus may escape, when the suppurating cornea is punctured.

The lamellæ frequently, however, becomes destroyed, and an abscess, with irregular lamellated walls, is found.

The weight of the pus, the pressure of the aqueous humor, and the distance of the pus from the surface of the cornea, modify the shape and size of the abscess.

The abscess rarely remains stationary for longer than a week, but perforation into the anterior chamber may occur, giving rise to hypopion, to iritis, etc.; or perforation outwards may be followed by ulceration, by escape of aqueous humor, with anterior synechiæ, or lastly, by opaque or staphylomatous cicatrices.

The extent and situation of the opacity, which mostly follows, depends upon whether the suppuration has been confined to the centre or to the margin, or whether the entire cornea has been affected.

Onyx signifies an accumulation of pus between the lamellæ of the cornea, the pus having gravitated in the inflamed portion, so as to assume a yellow and opaque crescentic figure, near the margin of the cornea. The onyx may remain stationary for several weeks, and not seldom occurs in connection with hypopion, *i.e.*, with an accumulation of pus, of shreds of corneal tissue, etc., at the most depending part of the anterior chamber. Hypopion frequently accompanies those large, flat ulcers which follow an injury, such as an abrasion of the surface of the cornea, in debilitated subjects.

The pus and fibrin are supposed to reach the anterior chamber by transudation from the cornea. They may finally become absorbed, or escape by perforation of the cornea. Onyx or hypopion may be complicated with an abscess in the iris. The pus, whether in the iris or in the anterior chamber, changes its position during certain movements of the eye. The inflamed and suppurating parts of the cornea may become rapidly destroyed; the cornea being changed into a gray, semi-transparent, pulpy, or flaccid, pale-yellow substance, which is sometimes thrown off by the pressure of the aqueous humor. Extensive suppuration may, however, subside, and leave the cornea transparent, or nearly so, if the pus is thick, and the intervening lamellæ of the cornea not destroyed.

Practically, we may distinguish—

(*a.*) Cases in which the suppuration comes on rapidly, in from one to three days, with great increase of vascularity and pain, with some chemosis, intolerance of light, and lachrymation. This form often follows operations or injuries, especially blows from stones, from branches of trees, etc., accompanied by abrasion of the cornea. It may also appear in the course of pustular corneitis and purulent ophthalmia.

(*b.*) Cases in which the suppuration appears slowly, and has been preceded by protracted corneitis, as in weak, ill-fed persons, suffering from syphilis.

(*c.*) Cases where there is no intolerance of light, or hardly any, with chemosis, mostly serous, with moderate, watery, or purulent discharge, and with rapid suppuration.

This form is observed spontaneously, or after operations on very old or decrepit persons, and after severe illness, fever, etc.

Suppuration, confined to the centre of the cornea, and occupying often its entire thickness, has been observed in children as an epidemic. In such instances, it has increased rapidly with ulceration, while the cornea adjoining the suppurating part has appeared hardly changed. This, in severe cases, has been accompanied by hypopion, turbid aqueous humor, a swollen, yellowish, or yellowish and vascular iris.

As regards the course of suppuration, it must be remarked that the rapidity of progress, and the extent of suppuration, are greatly influenced by the general health of the patient, the cause of the suppuration, by the state of the deeper parts of the eye, and lastly, by the treatment.

Purulent and diphtheritic ophthalmia, unless they have passed the acute stage, may cause suppuration of the cornea within 24 hours. During acute pustular corneitis, an abscess may have formed within 12 hours.

Increased vascularity and swelling, and a grayish color of the cornea next the seat of suppuration, with increased watering, indicate an arrest of the suppuration.

Treatment.—Our object in the treatment of suppuration of the cornea, besides attending to the state of the conjunctiva, to complications—as iritis—and to the preservation of the normal curvature of the cornea by a pressure bandage, is to check the suppuration.

An important means of effecting this is the application of warmth or cold according to the indications; the latter has a depressing effect, while the application of warmth is stimulating; and some tact is required in determining whether cold or warmth should be applied at a given stage. The same case, according to the too great or too little amount of reactive inflammation, may repeatedly require a change from cold to warmth.

The frequent application to the closed eyelids of lint dipped in cold water is indicated, if the suppuration is accompanied by a sensation of heat with much pain. These applications are discontinued as soon as cold is no longer pleasant to the patient.

Warmth or cold are applied by means of square pieces of lint (large enough to cover the eyelids and eyebrows), which are dipped into water, and squeezed out sufficiently to prevent the fluid from running over the patient's cheek. These, in severe cases, may, for one or two days, have to be changed every five or ten minutes.

The temperature of warm applications must be the higher the more quickly we wish to produce vascularity (reaction) at the seat of suppuration, *e.g.*, if the latter extends rapidly while the vascularity and sensation of heat are moderate or absent. Signs of reaction, and an indication to diminish or stop the warm applications, are swelling and opacity of the cornea round the suppurating portion, with increased vascularity, intolerance of light, and a sensation of heat. In addition to these applications, we adapt the local and general medical treatment of ulceration of the cornea.

Opening of the abscess by incision has proved of great advantage in cases in which no perforation had occurred. This little operation consists in thrusting the point of a lancet shaped knife, close to the suppurating part, through the healthy cornea into the anterior chamber, carrying it on so as to make an incision through the largest diameter of the suppurating portion, and bringing the point out again in the healthy cornea. The pus which is not washed away by aqueous humor while completing the incision, should be removed with a small scoop; after which any gray and opaque substance lining the walls of the abscess must be torn away with the forceps or sharp hook.

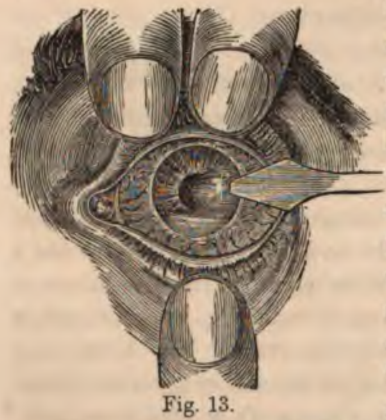


Fig. 13.

The lids, after the operation, are kept closed by a bandage, and atropia is applied twice daily, until an opaque cicatrix has formed.

DROPSY OF THE EYEBALL.

With a lancet-shaped knife a puncture or incision is made through the cornea, near its lower and outer margin. Prolapse of the iris and anterior synchia are less likely to follow if the incision is carried very obliquely through the cornea. The point of the knife, after having entered the anterior chamber, is dissected forwards and towards the cornea (to avoid wounding the iris), and should not pass beyond the margin of the pupil. The wound in the cornea, having reached a width of about ⅛th inch, the knife should be withdrawn slowly, when the fluid in the aqueous chamber is expected to escape.

A curette is inserted between the lips of the incision, if the fluid does not escape while withdrawing the knife. Keeping the eyelids open with the wire speculum, and fixing the eyeball with forceps, cause much pain and straining. We must give chloroform when using these instruments, or perform the operation without them.

SYNDECTOMY.

Syndectomy signifies excision of a large zone of conjunctiva and subconjunctival tissue from near the cornea.

The great pain, bleeding, etc., render the operation very tedious when performed without chloroform. The eyelids being kept open by the wire speculum, an incision is made with blunt-pointed (strabismus) scissors, about ⅛ inch from the margin of the cornea, through the conjunctiva, and is carried all round and parallel with that margin.

The conjunctiva, together with all the subconjunctival tissue which lies between the cornea and the incision, is then dissected from the sclerotic, together with some of the vascular substance upon the cornea. Small portions of conjunctiva near the upper and lower margins of the cornea, left for the purpose of rotating and fixing the eye during the dissection, are removed last. Particular care should be taken to cut and tear away all the bloodvessels and connective tissue from the part of the sclerotic which is situated between the margin of the cornea and the insertion of the tendons of the recti muscles.

The patient, after the operation, should remain in bed, and the eyelids should be kept closed, and lint dipped in cold water applied frequently. In some cases, on the fourth day, an opaque grayish-white substance (lymph?) is observed covering the exposed sclerotic. In most cases the sclerotic becomes covered with granulations. The swelling of the conjunctiva subsides gradually; its free margin approaches the cornea, and after from two to three weeks, we find in most cases a smooth substance covering the sclerotic. In 24 hours after the operation the surface of the cornea appears smoother, but more nebulous. On the eighth day, most of the bloodvessels upon it have disappeared, and the cornea becomes more transparent.

ANÆSTHESIA.

(*Loss of Sensibility of the Cornea.*)

Anæsthesia of the cornea has been observed during various morbid changes, *e.g.*, in the course of syphilitic corneitis, in some kinds of corneal ulcers, and in rapidly-forming protrusion of the eyeball; also, from impaired functions of the ciliary nerves, caused by ciliary staphyloma, by increased tension of the eyeball, etc. The anæsthesia may be partial or complete. The ophthalmia which often accompanies it is termed neuro-paralytic ophthalmia.

Incomplete division of the fifth nerve on one side is followed (in rabbits) by opacity of the cornea of the corresponding side. The opacity, after having reached a certain density, diminishes again.

Complete division of the semilunar ganglion always produces the same corneal changes, *i.e.*, a complete anæsthesia of the cornea, followed, after a few hours, by slight, and after 24 hours, by marked, central opacity. The epithelium on the surface of the cornea becomes dry (on account of the too small quantity of tears secreted), and the cornea more and more opaque and yellow. The conjunctiva, subconjunctival tissue, and the sclerotic (in the ciliary region) become vascular and slightly chemotic, in from 12 to 18 hours after the operation.

Though occasionally pus may be formed within the eye, and the entire cornea becomes yellow and opaque, yet perforation of the cornea never occurs.

The morbid changes, observed within the eye, are consecutive to those in the cornea. All these changes of the cornea are attributed to its inability (from anæsthesia) to protect itself against internal injuries.

The desire of the cornea for moisture, the reflex action upon the lachrymal gland, and protection (by the timely closure of the eyelids) are wanting.

The lids remain open too long, and dust, air, and other external irritants induce the above-mentioned changes, which on the other hand do not occur if ptosis exists simultaneously, or if the eyelids are kept closed.

In many, a roundish opacity in the lower half of the cornea, with anterior erynechia, indicates the spot where suppuration from anæsthesia has occurred.

If the anæsthesia is complete, we observe the cornea to become opaque, yellowish-white, softened, ulcerated (the ulceration advancing from the superficial towards the deeper layers), and finally perforated. These corneal changes, with the so-called neuro-paralytic ophthalmia, occur whether the trunk of the fifth nerve be implicated or not, as long as the cornea itself is anæsthesia.

Treatment.—Protection of the cornea, by keeping the lids continually closed with a piece of sticking-plaster, or with a bandage, effectually prevents the above changes, or leads to rapid recovery if they have appeared. Increase of tension is one of the most common intraocular causes of the anæsthesia, and requires iridectomy; if this has failed to effect a cure, and if the eye be blind and painful, excision of the eyeball is advisable. Incision, into an anæsthetic cornea heal readily. The general medical treatment depends upon the cause of the anæsthesia.

ABRASIONS OF THE CORNEA.

An abrasion of the cornea is the forcible removal of a small portion of the epithelium from its surface.

The impact of a foreign body as it flies rapidly past the eyes, the rebound of the twig of a tree or of a hedge, or the finger-nail of another person, may produce it. Mothers and nurse-maids are especially liable to this accident; the child they are nursing often unconsciously claws at the eye, and scratches the cornea, tearing off with its nail the epithelium with which it comes in contact.

At the first glance, the injury may appear slight, but it is very frequently the cause of much suffering, and sometimes of severe inflammation.

Symptoms of Abrasion of the Cornea.—Immediately after the accident there is photophobia, great lachrymation, conjunctival redness, with a feeling as if a foreign body were in the eye. On examination of the eye before a good light, and with the patient so placed that the light may fall obliquely on the cornea, the injury which has been sustained will be manifested by the glistening facet which will be seen where the cornea has been denuded of its epithelium.

Prognosis.—If it is a very simple abrasion without confusion, and in a strong and healthy patient, the eye will soon recover from the injury.

The abraded surface will first become cloudy, the sharp edge of the facet will be smoothed down, the epithelium will be restored, and the transparency of the part regained.

This accident, however, frequently occurs in mothers who are suckling; and as the period of lactation is unfavorable for the repair of injuries, very troublesome results often follow. The irritation which the scratch first excited may pass into a local inflammation, and pus between the lamellæ of the cornea may be formed, or a tedious ulceration in the site of the original injury may continue for many weeks.

The prognosis in these cases must be therefore guarded; for although, under proper treatment, they generally soon recover, yet the fact that it is not uncommon for them to give much suffering and anxiety to the patient, should cause them not to be too lightly esteemed.

Treatment of Abrasions of the Cornea.—If there is a simple abrasion of the cornea, and the patient is seen soon after the accident, a drop of castor or olive oil, or cream dropped into the eye, will give temporary relief, and may be repeated every two or three hours for the first day or two.

Gently closing the eye and applying over it a lint compress with a single turn of a soft roller will give great ease, by effectually excluding the eye from light, and by preventing the up-and-down movements of the lid, which serve to irritate the abraded surface.

If the eye is very painful, the bandage may be removed three or four times during the day, whilst the eye is bathed with hot water, or with a decoction of poppy-heads, and two leeches may be applied to the temple.

This local abstraction of blood, even in a feeble patient, is often of the greatest service, and may be repeated once or twice, if necessary.

In an ordinary case this simple treatment will be sufficient; but if untoward symptoms come on, such as ulceration or abscess of the cornea, or a general ophthalmitis is threatened, more energetic measures will be required. Warmth and soothing remedies are still best suited. A warm belladonna fomentation may be used, frequently applying it to the eye with a hollow sponge, so as to steam it, and thus relax and soothe the inflamed part.

In addition to this, two or three drops of a solution of atropine, gr. j ad aquæ ℥j, may be dropped twice a day into the eye. If the abrasion becomes converted into an ulcerated surface, and the cornea grows dull, and the aqueous turbid, and hypopion follows, tapping the anterior chamber with a fine needle, and letting off the aqueous, will often do good.

When abrasions of the cornea take on these unfavorable symptoms, as they frequently do, it is usually on account of some condition of the patient's health specially unfavorable for the repair of injuries. To great plethora, a constitution broken by drink and wrong living, anæmia, or one enfeebled from some exhausting cause, such as suckling, may retard recovery, or induce symptoms dangerous to the eye. Such conditions of system must regulate our constitutional treatment. In the one class of cases moderate antiphlogistic treatment will be called for; whilst in the other, the patient must be propped up by stimulants, and all irritation be allayed by sedatives.

Opiates in these cases are of the greatest service, and a few minims of the liq. opii sedativ., combined with liq. cinchonæ, given three or four times a day, will sometimes completely change the character of the inflammation, and induce a healthy action and a speedy recovery.

If it should be preferred to give the opiate in one dose at night, it should be sufficient in quantity to produce sleep, as a single moderate dose will excite rather than tranquillize.

ULCERS OF THE CORNEA.

Ulcers of the cornea are always the result of inflammation, and are always accompanied by it; for so long as an ulcer exists, it keeps up the inflammation.

These ulcers are of three kinds, *viz.*:—Superficial, deep, and transparent. When superficial, the corneal conjunctiva suffers most, and the ulcer is more extensive than when it is of the deeper kind. The deep ulcer is smaller, and of a funnel shape. The transparent ulcer is so called from its clearness, and the difficulty there is in observing it; indeed, it can only be seen in profile, whereas the others are seen when looking direct at the cornea; it appears as if it were a part of the cornea shaved off with a sharp instrument.

When an ulcer forms at the edge of the cornea, it is usually a deep groove, long and narrow, and is generally produced by the bursting of a pustule; it is not very dangerous, although it sometimes penetrates into the chamber of the eye.

The superficial ulcer is most frequently caused by the bursting of a phlyctenule; it spreads very rapidly over the surface of the cornea, and if not checked, will soon destroy its superficial layers, and finally terminate in an incurable staphyloma, by destroying the whole cornea.

The deep ulcer is frequently the result of an abscess of the cornea bursting externally; the great danger to be apprehended from it, is its penetration into the anterior chamber of the eye, generally followed by a prolapsus of the iris; and this will be the more unfortunate if the ulcer is in the centre of the cornea; scalding pain, profuse lachrymation, and sometimes intolerance of light, accompanying these ulcers of the cornea. The pain is caused by the extreme branches of the ophthalmic branch of the fifth pair of nerves being exposed to the tears.

The following remarks on the transparent ulcer are made by Dr. Walker:—"The transparent ulcer of the cornea has been long known and described; in some instances, however, we are unable to detect it when we examine the cornea in front, and only become aware of its existence by observing it in profile, or making the patient roll the eye about. There is, however, a symptom attending this form of ulcer with which we have been long acquainted, and which has not, that we are aware of, been heretofore described: it is the dark shadow thrown upon the surface of the iris by this ulcer, be it ever so transparent or so small, particularly when the patient stands opposite the light. At first view of this shadow, which is generally a dark circular spot, through which the natural color and striæ of the iris can be seen, it appears like an ordinary congenital mark; but from this it can be distinguished, by turning the head or eye from side to side, when it will be seen to shift its place on the surface of the membrane. The best termination there can be of an ulcer of the cornea is for it to heal; and as in every ulcer there is loss of substance, the consequence must be a cicatrix (leucoma), which will leave more or less of an opacity for life."

Treatment.—Much has been said on this subject in the articles on conjunctivitis and corneitis.

If the ulcer continues to increase, and does not present a healing appearance, the local application most to be depended upon is the nitrate of silver, the strength of which will depend upon the state of the ulcer; if it is a superficial or transparent ulcer, generally speaking, it will do to drop on it twice a day the ten-grain solution, which should be allowed to remain on the conjunctiva for three or four minutes; but if the ulcer is deep, and likely to penetrate into the chamber of the eye, or if it has already thus penetrated, then this ulcer must be touched to its bottom part with the pure nitrate of silver; and this is best and most easily accomplished by wetting the point of a fine camel's-hair pencil in water, and then applying it to a pencil of the nitrate of silver; the point of the brush should then be introduced into the ulcer, and immediately withdrawn, when the ulcer will be seen covered with a white coating. By applying the nitrate of silver in this manner, there is less danger of hurting the eye if the patient should suddenly start.

If, in a few minutes after the application of the nitrate of silver, there is much pain, it may be relieved by letting a little milk run over the eye. When the pure nitrate of silver is used in the morning, the ten or eight grain solution should be applied at night; in fact, an ulcer of the cornea is the better of being always coated with the nitrate of silver, for it gives the patient relief; as the great scalding pain is produced by the tears running over the raw surface of the ulcer, so, when the nitrate of silver is worn off, the pain that, for the time, had been relieved, returns again.

When once the healing process commences, the nitrate of silver should not be used in its purity; and as the ulcer improves, the strength of the solution may be gradually diminished.

When the ulcer begins to heal, a few red vessels will be seen to run into it and feed it, which is always a good symptom; though, strange to say, some have considered it a cause of the ulceration, and have gone so far as to take hold of these vessels with a forceps and cut them across. A most erroneous idea was, that the inflammation kept up the ulceration, when, in reality, it is the ulcer which keeps up the inflammation.

While the nitrate of silver is thus being used, much benefit will be derived from brushing the upper eyelid and around the upper part of the orbit with the solution of veratria.

During the above treatment the patient should take quinine, with very minute doses of tartar emetic; he should have air and exercise, and be allowed a free, wholesome diet; if that light should give pain, he may have his eyes shaded, but not closed up, with a bandage, as it is too often the case. The eyes should have rest till they are perfectly well.

For the treatment that should be adopted when the ulcer penetrates into the chamber of the eye, and is followed by a prolapsus of the iris, I must refer the reader to my remarks upon prolapsus of the iris.

I would here, however, quote a few valuable remarks made by Dr. J. B. Walker on the treatment of prolapsed iris:— "We still believe the best thing that can be done in penetrating ulcers of the centre of the cornea is to touch the rupture with a weak solution of the nitrate of silver, applied with a fine camel's-hair pencil (but if the iris has protruded, it is better to omit this); then to drop into the eye a strong aqueous solution of atropine; to close the lids carefully with a bit of isinglass plaster, extending from the forehead to the cheek; to apply the extract of belladonna plentifully, in the usual manner, all around the external parts; to lessen congestion and inflammation by local depletion, such as cupping or leeching, etc.; and, to relieve whatever other urgent symptoms may be present, to confine the patient to bed or the recumbent posture; to enjoin extreme rest, and not to meddle with the eye for 48 hours, at least."

The reader must at once perceive that Mr. Walker speaks of prolapsus through the centre of the cornea; therefore it must be borne in mind, that if the perforation is in the edge of the cornea, the use of atropine and belladonna will only favor a prolapsus of the iris.

Neutral-tint spectacles are highly recommended in this disease, to moderate the light.

OPACITY OF THE CORNEA.

Difference of color, shape, structure, origin, etc., of the opacity, have given rise to various terms. Nebula signifies a semi-transparent, bluish, or grayish opacity, which shades off into the normal tissue. A cornea with one or several nebulæ is termed nebulous. The nebulæ may be superficial (in front, or immediately beneath the anterior elastic lamina) or deep-seated.

The substance which gives rise to superficial nebulæ, when examined microscopically, and in sections, appears granular, very dark, and situated immediately beneath and upon the anterior elastic lamina.

It consists of ill-shaped corneal and epithelial cells, of obliterated bloodvessels, and of slightly opalescent lamellæ of the cornea.

Causes.—Corneitis (especially the syphilitic form), slight pannus, and ulcers (the loss of substance having been repaired by semi-transparent material).

Leucoma (albugo-fibrous opacity, cicatrix in the cornea).

The term leucoma is applied to a dense white or gray opacity, which occupies the place of the entire (total leucoma) or part of the cornea (partial leucoma), and which prevents a view of the parts behind it. The leucoma may have the color of chalk or of fibrous tissue. It may be well-defined, surrounded by cornea, or shaded off. It may extend to a limited depth into the cornea, or occupy its entire thickness, and likewise project beyond its curvature.

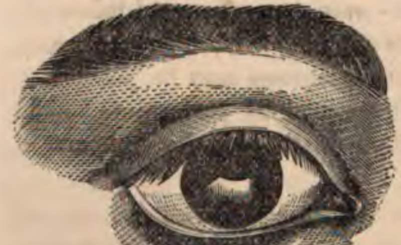


Fig. 14.

The leucoma may become staphylomatous, or ulcerate. Several leucomata may stand side by side, *e.g.*, when the result of severe pustular corneitis. Large bloodvessels pass, sometimes, through the leucoma.

In leucoma, as in nebula, we sometimes find (on microscopic examination) the opacity to consist of new, ill-shaped cell-strata, situated between the lamellæ of the cornea, or accumulated in one spot. In other cases the lamellæ themselves appear opaque, with a gray, or yellow, or brown powdery substance, with *debris* of bloodvessels, and with granules of chalk accumulated between them. Such leucomata occur after severe syphilitic, or after a slight suppurative corneitis.

In leucoma following ulceration, we sometimes find the lamellæ of the cornea semi-transparent, and covered with opaque epithelial cells, while the anterior elastic lamina is found missing to the extent of leucoma.

The leucoma which is developed out of the lymph which covers a prolapse of the iris, frequently becomes staphylomatous. Examined microscopically and in transverse sections, it may present the appearance of vascular papillæ, cut transversely.

A leucoma occupying the entire thickness of the cornea, is generally complicated with anterior synechia.

The presence of pigment or blood, or of adhesions of the iris or of the lens, giving rise to reddish, brownish, or bluish spots, which are mixed up with the original white and opaque color of the leucoma.

Clavus of myocephalon, with some, signifies a deposit of pigment in a leucoma; while with others the term is confined to a black or bluish-black spot in the nebulá, or in the leucoma; which spot is caused by urea, covered by a thin layer of the fibres of the iris, or by semi-opaque connective tissue.

The myocephalon is frequently staphylomatous; and not seldom an opening (fistula) is observed in it, leading into the posterior aqueous chamber.

Chalky or bony substance is found, more particularly if extensive suppuration have preceded the leucoma.

Opacities of a well-defined white, or yellowish-white, or brownish, or even black color, are occasionally observed after using lotions containing acetate of lead, or phosphate or carbonate of lime. Particles derived from these salts, of which the sugar of lead is the one most frequently used, become deposited and fixed among the granulations of the ulcer.

The opacity may occur sympathetically in both corneæ; it may change color as it becomes older, or may remain stationary for years. Greenish-white, yellowish, brownish, or black minute dots, situated at different depths in the cornea, and more frequently in its lower half, occur especially after syphilitic corneitis. If situated in the epithelial layers, they have been found to consist of clusters of altered epithelial cells. These, with some of the adjoining anterior elastic lamina, have been removed successfully by operation.

Round bright-red spots, consisting of blood effused among the lamellæ of the cornea, have been observed. One of these, of several months' duration, has been removed successfully by operation.

Vision.—The disturbance of vision observed with opacities is to be attributed partly to loss of transparency of the cornea, partly to diffusion of light, and partly to alterations of curvature. Hardly perceptible opacities (nebulæ), especially if opposite the pupil, very much impair vision by diffusing the light, instead of allowing it to become regularly refracted. The greater the quantity of diffused light which reaches the retina, the more misty do objects appear.

If such an opacity occurs only in one cornea, and an object is viewed with both eyes, an impression is produced as if a mist intervened between the eyes and the object. Patients complain of "the sight of one eye dazzling that of the other;" and frequently close the eye with the opacity, or "squint," while reading. If opacities occur on both corneæ, the best eye is used by preference. In children, myctagmus frequently becomes developed.

A larger field of vision is obtained if the inner half only of the pupil is obscured by an opacity. Patients with opacity, when looking at near objects, and using the defective eye, see better when turning the back to the light.

Amblyopia sometimes ensues from the retina not receiving good impressions, and may continue after the opacity has disappeared.

Small and dense opacities (leucomata) at or near the middle of the cornea, cause no diffusion of light, or much less than nebulæ. Besides the diffusion of light and the disturbance caused by alterations of curvature, we occasionally observe, after ulceration or suppuration, that some change has occurred in the arrangement of the lamellæ of the cornea. In such cases, the cornea may have again become transparent, and may appear of normal curvature, as far as can be ascertained by the shape of reflex images. The contours of the optic disc, and of the retinal vessels, viewed through those parts of the cornea, appear distorted, like objects viewed through flows of glass.

Treatment (1) *by Medical Agents.*—The more recent or the thinner the opacity, and the younger the patient, the greater are the chances of improvement. A considerable portion of the cornea, when destroyed, may become replaced by transparent substance.

In children, the growth of the cornea in itself materially assists in the removal of opacities. Thus, opacities following purulent ophthalmia, and occupying nearly the entire cornea, may, without any treatment, disappear within two years, while in adults even slight opacities often remain for life.

Densely-opaque, long, earthy, or metallic deposits remain unchanged, unless very near the surface of the cornea. In the latter case, earthy deposits have been known to become eliminated slowly, and with much irritation.

Dense opacities, if confined to one eye, the other being undisturbed, are best left alone, unless they be opposite the pupil, when surgical interference is indicated. Changes in the eyelids and conjunctiva (tinea, trichiasis, granulations, etc.), tending to maintain the opacity, must first be removed by treatment.

The object of medical agents, applied to the cornea for the removal ("absorption") of opacities, is to produce an irritation in the cornea, or, strictly speaking, slight corneitis. Dense opacities have been known to disappear spontaneously during an attack of purulent ophthalmia causing corneitis. No irritating remedies should be used as long as undue sclerotic or conjunctival vascularity, pain, watering, intolerance of light, or increased sensation of heat exists.

The symptoms of irritation produced artificially, are: increase of vascularity of the conjunctiva, sclerotic, and cornea; watering, intolerance of light, and pain. The pain following the application of local remedies should last from five to ten minutes. The duration of the pain affords the means of measuring the amount of irritation produced. The patient has to find by experiment what strength of the lotion, etc., suits him best. He should be told that if the pain lasts longer than fifteen minutes, the remedy, lotion, etc., has to be made weaker. Changes in the strength of the remedies may be required at different periods. Lotions or drops produce less irritation than ointments.

I have found, in my practice, highly-concentrated hydrocyanic acid to be an excellent remedy in opacities of the cornea, and good effects from its use in many cases of speck, especially in nebula consequent to corneitis.

The plan I pursue is that of putting a drachm of a medicine into a bottle (containing a small piece of sponge) of about two-ounce size, having a mouth precisely fitted to the eye, and with a ground-glass stopper.

I tell the patient to hold it, in close contact with the eye, the eyelids being open for the space of about half a minute, or until such time as the patient feels a little warmth, or the person holding the vial sees the pupil greatly dilated, and the vessels of the eye injected with blood, which is the invariable effect of the application of the acid. The patient is not sensible of pain from this peculiar state being induced, which appears to me to result from the powerfully sedative influence of the acid, thereby showing that two opposite powers—to wit, the stimulating and the sedative—are exerted at the same time; and thereby the uneasiness arising generally from a stimulant alone is prevented. Its great power in removing these diseases chiefly arises from the two powers being so blended, and thus enabling the eye to bear a sufficiently stimulating action without injury.

The person who holds the acid to the eyes should *be careful not to allow the patient to smell it.* Ten minutes after the vapor is dropped on the conjunctiva, 1 or 2 drops of castor oil, at intervals of every two or three days; after which, 3 drops on the conjunctiva. A solution of the sulphate of cadmium (grs. from ij to v ad aquæ ℥j), once or twice a day, 1 ounce glycerine, and 1 drachm of tannin, is found to be an excellent remedy in opacity of the cornea.

The remedies which are in general use in the treatment of opacities are: Calomel powder—it is best suited if the eye is irritable; oleum terebinthinæ, mixed with varying proportions of olive oil, commencing with one part of the oleum terebinthinæ to four parts of the oleum olivarum. Pure oleum terebinthinæ is prescribed, if much irritation is required. Sulphate of copper, acetate of lead, acetate of silver, etc., have been superseded by the oleum terebinthinæ. Guttæ potassii (grs. ij potass. iodid. ad aquæ distill. ℥j) produce the smallest amount of irritation.

Tincture opii, mixed with varying proportions of water, according to the irritation required, is recommended, to induce repair of indentations left in the cornea after ulceration. The smarting sensation produced by the lotion, when applied to the conjunctiva, should not last longer than about ten minutes.

The above remedies may be tried in all kinds of corneal opacities. They are useless if applied to opaque cicatrices of the iris, the latter being adherent to the cornea.

Calomel powder is particularly recommended in opacities following pustular corneitis; oleum terebinthinæ in the nebulous condition caused by the syphilitic corneitis. The remedies should be applied from three to five times daily, and continued for several months.

The drops and the calomel powder are applied with a camel's-hair brush three times daily; the lotions, by bathing the eyelids; the ointments, by placing a small quantity upon the conjunctiva.

An examination of the field, and of the acuteness of vision, should be made from time to time, to ascertain the progress made. The local applications must be discontinued if no decided improvement of vision is observed after from two to six months.

Dr. Mackenzie, of Glasgow, speaks highly of the vapor of hydrocyanic acid. He says: "I have witnessed good effects from its use in many cases of speck, especially in nebula consequent to corneitis."

Treatment (2) *by Optical Means.*—In persons with opacity of the cornea of both eyes (or of one, the sight of the other having been lost), we should carefully ascertain whether vision can be usefully improved by stenopæic remedies, or by cylindrical or spherical lenses. Stenopæic remedies limit the field of vision, and are only applicable for reading and near work. Their object is to cause a limited portion of the retina to be strongly illuminated, while the light is kept completely excluded from the rest.

We first, by lateral illumination, ascertain the density and size of the opacity; and then, by experiment, find the size and the direction of the opening, which, held closely in front of the best part of the cornea most improves the patient's vision.

During these experiments all side light must be excluded, and a point of light be used as the object for the patient to look at. Having found the opening which suits best, a pair of stenopæic spectacles is prescribed, having the proper opening.

The patient must be shown in what position to hold objects so as to derive most benefit from the spectacles. Spherical (the usual convex and concave) and cylindrical lenses, and likewise the effect of atropia and of calabar, should be tried.

These remedies are sometimes of benefit only after the application of surgical means—*e.g.*, after an iridectomy.

Vision for distant objects, unless the opacity be very faint and the curvature of the cornea but slightly altered, is rarely improved by spectacles. It is more particularly for reading and "near work" that optical means are of use. In the selection of spectacles, we must be guided by the rules laid down under mopia, hypermetropia, and especially under astigmatism.

Treatment (3) *by Surgical Means.*—The operation for artificial pupil should be recommended if the opacity is dense and opposite the pupil, the rest of the cornea being clear; or if the operation is likely to increase the field of vision or the quantitative perception of light.

Every case requires special study as regards the modification of the operation.

The artificial pupil should be made behind the most transparent portion of the cornea, and should be as central and defined as possible.

Iridesis displaces the pupil towards the incision in the cornea, and may thus remove it altogether from behind the opacity. If we have the choice, we make the new artificial pupil inwards and downwards. We make the artificial pupil near the upper margin of the cornea, if only one eye is left; or if both are similarly affected, the upper part of the cornea alone being clear. In these cases, we also divide the upper and lower recti muscles, and advance the insertion of the latter, so as to carry the artificial pupil more into the area of the palpebral aperture.

Iridectomy, or a large artificial pupil, is preferable, if the cornea is nebulous; and especially if the reflex images of its surface indicate much irregularity.

Changes in the surface of the cornea may render the best-performed operation useless. We should, therefore, previous to operating, be careful to dilate the existing pupil, and with the ophthalmoscope and with stenopæic remedies ascertain the healthiest part of the cornea (see *Conical Cornea*); or if these means of examination are inadmissible, we should determine what part of the surface of the cornea furnishes the most perfect reflex images.

We again try optical means, especially cylindrical lenses, after all vascularity and opacity caused by the operations have subsided.

OPACITY OF THE CORNEA FROM LEAD.

This is a form of opacity of great importance to recognize, as it admits of very considerable relief, and, in many cases, of complete cure. It may be said to be the result of treatment rather than of injury or disease. It is occasioned by the use of a lead lotion when the cornea is ulcerated or abraded; the lead is deposited on the surface as a carbonate, producing a milky-white patch, which is often sufficiently opaque to occlude either the position of the iris, or the pupil which lies behind it.

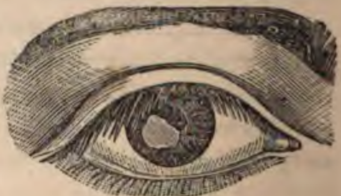


Fig. 15.

This figure represents the opacity of the cornea from lead.

The treatment consists in removing the layer of lead deposit which has coated the abraded surface of the cornea. This may be done with a small knife curved convexly on its cutting edge, as in Fig. 16. A speculum being introduced between the lids, the operator with one hand fixes the eye with a pair of forceps, while with the other he gently scrapes the whitened surface of the cornea with the knife, until, having detached the epithelium, he comes down to the thin coating of lead; steadily but gently scraping, he will generally succeed in detaching all that is required. Where the lead is rather thicker deposited it will chip off in filmy scales, but where it is very thin it has to be scraped off as fine powder. It is well, if possible, to remove the whole of the lead deposit from the cornea, though in some cases this cannot be readily accomplished; but care should always be taken to clear thoroughly that portion of the cornea which is opposite to the pupil.

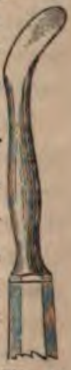


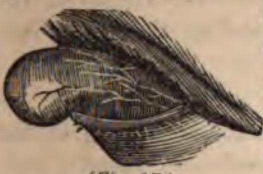
Fig. 16

When the operation is completed, a few drops of olive oil should be dropped into the eye, and a fold of wet lint laid over the closed lids.

The oil may be afterwards dropped two or three times a day into the eye, if it gives ease. The operation should be performed under chloroform, as it is exceedingly painful, and perfect stillness on the part of the patient is absolutely necessary. A certain amount of irritation will follow the operation; but if it is carefully performed, the case is almost certain to do well. If the eye should continue for several days painful and irritable, two leeches to the temple, and a lotion of belladonna to the eye, will generally suffice to remove all discomfort.

STAPHYLOMA.

The cornea is subject to changes in figure as well as to the alteration of texture which impair or destroy its transparency. The term staphyloma denotes an increase of size, with change of figure in the membrane (fig. 17), these alterations being accompanied almost invariably by more or less opacity; it is derived from the Greek word *staphule*, which signifies a grape. The name was originally applied to that projection of the cornea in which its texture, having been weakened by alterations of structure, consequent on the inflammatory process, yields to the pressure of the fluid contained in the posterior chamber, and is elevated into a rounded prominence on the front of the eye, the iris being adherent to its internal surface, and stretched out so as to afford it a thin general lining. The term has since been applied more extensively, having been given to other tumors of the front of the eye, and even to expansion of the coats in other directions. However, when the term staphyloma is used alone, it is understood that staphyloma signifies an anomaly of curvature of the tunics of the eyeball.


(Fig. 17.)

It has been observed in most portions of the tunics. Of the numerous varieties of staphyloma, those of the cornea and those occupying the place of the cornea are the most frequent. A protrusion of one of the tunics, *e.g.*, of the posterior elastic lamina of the cornea, or of iris, or of the retina, etc., through an uncer or wound, is termed a hernia or prolapse. If coated over with lymph, or if cicatrized and still protruding, it is termed a staphyloma.

Among anomalies of curvature of the cornea we distinguish: (1.) *The globular cornea;* (2.) *The conical cornea;* (3.) *A staphylomatous condition of an opaque or nebulous cornea, caused by inflammatory changes, ulcers, etc.;* (4.) *Staphylomatous cicatrices occupying the place of protrusion, or of the entire cornea, caused by cicatrized prolapse of the iris.* In the sclerotic we distinguish *the ciliary, the equatorial, and the posterior staphyloma.*

Ciliary staphyloma may occupy any portion of the ciliary region, *e.g.*, of the sclerotic between the margin of the cornea and a line which passes through the ocular insertions of the recti muscles.

Posterior staphyloma generally occupies the region of the yellow spot, or that of the tunics surrounding the optic disc. (See *Globular and Conical Cornea.*)

Staphyloma of an opaque or nebulous cornea may be the result of inflammatory changes, ulcers, etc., occupying in the course of inherited syphilis, measles, scarlatina, variola, etc., or following injuries or operations on the cornea.

Syphilitic corneitis and pannus, implicating the entire cornea, may give rise to rapid staphylomatous changes, the whole of the softened corneal tissue yielding to the pressure of the aqueous humor.

Vision, in these cases, varies according to the degree of opacity, of alteration of curvature of the cornea, and especially of disturbance of the media and of the retina. Some patients, if the opacity is but slight, complain of weakness of sight; others, of being near-sighted; others, of objects appearing distorted. Only distinction of colors of quantitative perception of light may exist, though the staphylomatous cornea may seem but slightly nebulous. (For treatment, see *Opacities of the Cornea.*)

Staphylomatous opaque tissue—cicatrices—occupying the place of portions or of the entire cornea, generally originates in the following manner: A portion of cornea having been destroyed by ulceration, suppuration, etc., the iris, after the escape of aqueous humor, comes to lie against the opening in the cornea.

The iris undergoes adhesion to the margin of the opening. Granulations, lymph, etc., are thrown out on the exposed surface of the iris, and become changed into more or less opaque tissue.

The rapidity of formation of this opaque tissue, its strength, and the nature of the treatment, influence the formation and size of the staphyloma.

The surface of the staphyloma is frequently uneven, or sprinkled with portions of pigment. The staphyloma may be extremely thin, and nearly transparent in parts. In the latter case, it appears black (myokephalon), from the interior of the eye shining through the transparent portion. In other cases, the staphyloma is considerably thicker than the cornea. It becomes covered with dry epithelial scales, especially during sleep, if its surface be exposed to the air too long.

Beneath the epithelium we may find connective tissue, or tissue resembling that of the cornea, but most frequently white fibrous tissue intermixed with bloodvessels. The staphyloma may become inflamed, or ulcerated, or thin portions may burst, and the aqueous humor escape. The staphyloma may temporarily collapse; or the lens, or "vitreous," or both, may escape.

The collapsed tissue may again become distended by fluid. Bleeding from the choroid veins, between the sclerotic and choroid, has followed the rupture of the staphyloma in some cases, and ophthalmitis in others. The base of the staphyloma passes, either gradually or abruptly, into adjoining cornea or sclerotic. The posterior surface may be smooth or uneven. At the portions covered by posterior elastic lamina no adhesions of the iris are formed.

The *debris* of black or brown pigment on the posterior surface of the staphyloma belong to the distended iris. An instrument, thrust through the staphyloma into the eye, at once enters the posterior aqueous chamber. The lens, together with its capsule, may be missing; or it may be opaque, or adherent to the staphyloma, or more or less displaced, though not adherent.

Recurrent attacks of staphyloma or of iritis may occur (from the partial adhesion of the margin of the pupil to the staphyloma, or from disturbance caused by displacement, etc., of the lens), with or without sympathetic changes in the fellow-eye.

We frequently meet with glaucomatous changes, if the staphyloma has appeared some time after "some inflammation of the eye." These, together with cicatrix in the cornea, produce a degree of impairment of sight which is very much greater than that caused by staphyloma alone. In these cases, if abscission be performed, intraocular hemorrhage, or suppuration, often follows the operation.

Treatment.—A staphyloma, if left to itself, may remain stationary for years. It may, on the other hand, burst frequently, and occasionally give rise to the changes mentioned above. The rupture relieves the patient temporarily; and many, to obtain ease, soon learn to puncture the thinnest part, or the one they observe giving way spontaneously, and thus for years alleviate the distress caused by the size of the staphyloma.

In recent prolapse of the iris, or in sloughing of portions of cornea, we order a bandage to be applied over the closed eyelids, to prevent the occurrence of staphyloma.

The bandage has to be removed repeatedly during the day, and atropia applied, to lessen the tension of the eye during cicatrization. An iridectomy, done at this stage, and followed by gentle pressure, will be found of great service. The eyelids should carefully be kept "bound up" until a firm cicatrix has formed.

Staphyloma of long standing is treated by iridectomy, with removal of the lens, and by abscission of the staphyloma, if part of the cornea is clear and the retina sensitive throughout. If the walls of the staphyloma appear thin, a good cicatrix may be obtained by first puncturing the staphyloma. The fluid, accumulated behind, is allowed to escape. A vertical incision is made with scissors through the staphyloma, from apex to base. By properly applied pressure, assisted, if necessary, by a suture, its walls are made to overlap one another, and are left to contract adhesion (the anterior surface of the one part of the staphyloma with the posterior surface of the other).

The eyelids are kept "bound up" until all vascularity of the conjunctiva and sclerotic has subsided. Excision or abscission of the eyeballs is indicated, if the staphyloma causes pain or sympathetic irritation of the fellow-eye. The patient, if he wishes the operation performed for reasons of personal appearance, and if there be perception of light with the staphylomatous eye, should be informed of the loss of the perception of light by the operation, and also of the trouble connected with the wearing of an artificial eye.

A better result, as regards appearance, is obtained by incision. The repeated occurrence of suppuration of previously abscised eyes, and of continuance of sympathetic irritation, indicate, in poor persons, excision as the quicker and safer treatment. Abscission should always be performed in staphyloma following purulent ophthalmia.

THE SCLEROTIC.

GENERAL AND ANATOMICAL REMARKS.

The sclerotic is a fibrous capsule, with a large opening for the passage of the optic nerve, and with numerous smaller apertures (situated especially, some immediately, in front of, and some behind, the insertion of the recti muscles, and round the optic nerve) for the bloodvessels and nerves of the choroid. The surface of the sclerotic is slightly grooved (just behind the insertion of the recti muscles) for the reception of tendons. It is very slightly depressed at the line of junction with the cornea. At this spot is situated *the circular sinus* or *canal of* Schlemm.

The sclerotic moves within a capsule termed "Tenon's capsule," or *sub-"conjunctival fascia,"* which, is attached to the margin of the orbit behind the suspensory ligament of the eyelids, and which, further back, merges into the sheath of the optic nerve.

This capsule isolates the eyeball from the soft parts of the orbit. The muscles of the eyeball (loosely attached to this capsule) pass through it to reach the sclerotic. Behind their insertion connective tissue is found between the capsule and the sclerotic.

The sclerotic receives but few bloodvessels and nerves. The subconjunctival tissue in front of the insertion of the recti muscles is nourished by capillaries, which anastomose with bloodvessels going to the ciliary processes and therefore overfulness of the latter, whether chronic or acute, betrays itself by enlargement of vessels upon the sclerotic, near the margin of the cornea.

The sclerotic, otherwise of a dead white color, appears brilliantly white where it is covered by conjunctiva. The thicker the sclerotic, the whiter it appears; the thinner, the more bluish. In dark persons, brown or black pigment spots may be seen in its ciliary portion. In highly myopic persons it often appears bluish (semi-transparent) about the region of the yellow spot. Prolonged congestion of the ciliary veins leads to enlargement of their respective sclerotic apertures.

To become familiar with the shades of color of the sclerotic, which lie within the limits of health, we should examine the sclerotic of many fair and dark persons. The color of the inner (choroidal) surface of the sclerotic can, in fair persons, be readily seen with the ophthalmoscope, while in those of dark complexion (who have a highly pigmented choroid) too little light reaches the sclerotic to render it conspicuous. If the sclerotic is very thin, some light passes through it, and the large bloodvessels can be perceived in its substance.

The thickness of a healthy, full-grown sclerotic, near the optic nerve, amounts to $\frac{1}{22}''$; a quarter of an inch behind the margin of the cornea, to $\frac{1}{38}''$; and immediately behind the insertion of the recti muscle, to $\frac{1}{56}''$. In some cases, when the vitreous is removed, the sclerotic and the adjoining tunics are thrown into folds; in other equally healthy eyes they remain expanded, and retain their curvature, even though all the vitreous may have been removed.

Arrangements and proportions of the different kinds of tissue of which the sclerotic is composed vary in different parts, especially along the margin of the cornea, at the optic nerve, at the region of the yellow spot, and round the apertures for the choroidal nerves and bloodvessels.

The sclerotic, generally speaking, consists of an interlacement of white fibrous tissue with broad bands of connective tissue interwoven with yellow elastic fibres.

DEVELOPMENT.

Before the third month of fœtal life, no difference of appearance is observed between cornea and sclerotic. Both are almost transparent, and extremely thin. A circular, prominent fold appears as the first indication of a boundary between cornea and sclerotic. The part encircled by the fold becomes the cornea. The small, round, transparent globules of which, at that period, the sclerotic consists microscopically, become intermingled with fibrillæ. About the middle of the third month, the cornea, for a short time, becomes opaque, but soon resumes its transparency, while the sclerotic remains opaque, its inner surface presenting a silvery lustre. About the middle of the third month, when the sclerotic protuberance is perceptible, a thick network of bloodvessels appears upon the outer surface of the sclerotic, close behind the insertion of the recti muscles; it forms a kind of circle round the eyeball, and gradually extends towards the cornea and towards the optic nerve. These bloodvessels assist in the formation of the greater portion of the fibrous structure of the sclerotic.

The sclerotic rapidly increases in thickness and density about the middle of the fifth month. About this time the fœtal changes of shape of the eyeball and the closure of the fœtal fissure are completed.

CONGENITAL ANOMALIES.

A double sclerotic, the rudiments of a second being situated within an entire one, has been observed. Bluish spots in the sclerotic, or a general bluish (semi-transparent) tint, due to great thinness, are frequently observed in infants. Remnants of the sclerotic protuberance have occurred in micro-ophthalmic eyes. Prominences beyond the general curvature are not uncommon round the insertion of the recti muscles, or round the optic nerve.

TUMORS.

Little "dermoid tumors" are generally congenital. At their bases they are adherent to the sclerotic, and at their summits to the conjunctiva.

Hairs are often found projecting from their surfaces. They are easily removed. (See *Tumors of Conjunctiva*, and of *Cornea*.)

Staphyloma, especially in the ciliary region; "strumous deposit" in the same region; medullary, and especially melanotic, cancer (often found upon the equatorial part of the sclerotic), have been mistaken for tumors of the sclerotic itself.

INFLAMMATION.

The sclerotic is frequently involved in inflammation of adjoining tunics—*e.g.*, of the conjunctiva, or of the ciliary processes.

Circumscribed inflammation of the sclerotic, together with that of the subconjunctival fascia and conjunctiva, is mostly of syphilitic origin.

The inflammation commences in the sclerotic, and frequently in its ciliary region, where it forms patches of a purple tint, covered with larger vessels. The vascular sclerotic and the subconjunctival tissue appear swollen. The inflammation subsides spontaneously after from five to ten weeks, leaving the sclerotic slightly discolored, semi-transparent, and thinner. Attacks of circumscribed inflammation often appear successively in adjoining parts of the ciliary region of the sclerotic.

Treatment.—The circumscribed inflammation readily subsides under the use of bichloride of mercury (from $\frac{1}{24}$ to $\frac{1}{16}$ of a grain to be taken twice daily in some water), and the local application of atropia (a few drops of the solution "to be dropped into the eye" twice daily). The same treatment is adopted if a new attack appears, which often happens at the same season of several succeeding years.

If this treatment should not succeed, syndectomy can be recommended.

RHEUMATIC INFLAMMATION OF THE SCLEROTIC.

In rare cases we meet with an acute, diffused, purple redness and slight swelling of the sclerotic, with extreme intolerance of light and great pain, brought on by exposure to cold.

When minutely examining a section of such a sclerotic, we find in the inflamed portion groups of what appear to be connective tissue corpuscles. The latter are swollen, and their stellate processes anastomose with each other, and with those of neighboring groups. Their granules change into cells, and, probably by subdivision, increase in number. The substance, intervening between the nests of corpuscles, gradually disappears, or, if the inflammation is very acute, is changed into a yellowish pulpy substance ("slough"), while the nuclei and cells of the connective tissue corpuscles undergo fatty degeneration.

Treatment.—The frequent application of pieces of lint, dipped into hot lotio papaveris, and of chloroform liniment to the skin of the eyelids, forehead, and temple, are prescribed, together with frequent instillations of atropia.

The eyes must be kept excluded from light. The general medical treatment depends upon the state of health of the patient.

INFLAMMATION OF TENON'S CAPSULE.

This form of "sclerotic" inflammation is a common occurrence in the course of ophthalmitis. The subconjunctival fascia becomes adherent to the sclerotic, etc.

Inflammation of circumscribed portions of the subconjunctival fascia has been observed in myopia, in tumors of the orbit or eyeball, and occasionally after exposure to cold. The inflammation is accompanied by slight ptosis, and by a sensation of tension in the eyeball. Sometimes there is severe pain in and around the orbit, with vascularity and serous chemosis of the conjunctiva. The eyeball is slightly protruding, and its movements are slow and painful.

Treatment.—Cold fomentations, or the local application of ice, should be tried first, with a number of leeches (proportionate to the strength of the patient) applied to the skin of the corresponding temple. Fomentations with warm or hot lotio papaveris are ordered, if the cold should be unpleasant to the patient. If ophthalmitis, or intraocular tumors, should be the cause, excision of the eye may become necessary.

ULCERATION OF THE SCLEROTIC.

An ulcer of the sclerotic is preceded by yellowish-gray, opaque, and circumscribed infiltration of the sclerotic.

The margins of the ulcer are abrupt, the base yellowish-white and opaque. This is accompanied by much redness and swelling of the surrounding sclerotic and conjunctiva.

A patient, who some months ago left the Eye Infirmary after recovery from a syphilitic ulcer of the lower lid, lately presented himself with two deep ulcers in the lower and outer part of the sclerotic, with ulceration of the cornea, and with some iritis. The ulcers healed rapidly under the application of the ungt. hydrarg. nitrat. mitius. A quantity of the size of a small pea was rubbed into the ulcers twice daily.

Cancerous ulcerations of the eyelids may encroach upon the sclerotic.

STAPHYLOMA OF THE SCLEROTIC.

Staphyloma of the sclerotic signifies a tumor formed by the protrusion of this membrane beyond its natural level.

The exciting cause is usually an abnormal accumulation of aqueous humors in the posterior chamber of the eye, in consequence of the occlusion of the pupil, or of the attachment of the iris to the surface of the cornea. The pressure thus occasioned produces atrophy, and, finally, excessive attenuations of the sclerotic, followed by a separation of its fibres and the protrusion of the other membranes of the eye. The fact is, the mode of formation is identical with that of the pouches which sometimes occur in the intestines and the urinary bladder, and which are so minutely described in most works on pathological anatomy.

The affection is always accompanied by a discolored and disorganized condition of the inner structure of the eye. The size of the tumor varies from that of a currant to that of a hazelnut; it may be rounded or ovoidal in its shape, and has usually a bluish, purplish, or blackish appearance, from the presence of the coloring matter of the choroid. When the membrane is diseased at several points, there may be a corresponding number of protrusions, occurring either singly or inclusters.

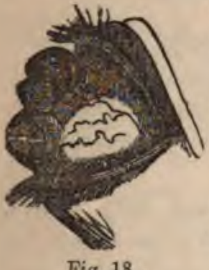


Fig. 18.

The annexed sketch (Fig. 18.) conveys an excellent idea of the situation, size, and shape of these tumors.

The spots of sclerotic, through which choroidal veins pass, become frequently staphylomatous in the course of chronic morbid changes, accompanied by increase of tension.

The size, shape, and color of the staphyloma vary. Small ciliary staphylomata appear as bluish, bulging, smooth spots or specks, alternating with more healthy (white) portions of the sclerotic, and radiating from near the margin of the cornea. The staphylomata, which formerly were supposed to be varicose veins of the choroid, are atrophic portions of the tunics of the ciliary region separated from each other by more healthy parts.

Ciliary staphylomata lead to displacement of the cornea, and, with it, to alteration of the distance between the insertion of one, or of several, of the recti muscles, and the margin of the cornea.

The equatorial staphyloma is frequently observed behind, or at the side of, the sclerotic insertion of the superior rectus muscle. It has been mistaken for intraocular tumor, of which, however, it may be a complication.

In the discovery of the morbid changes which accompany staphyloma of the sclerotic, we are assisted by the ophthalmoscope, by light concentrated upon the tunics by means of a strong convex lens, and by ascertaining the tension of the eye and the function of the ciliary nerves (the sensibility of different parts of the cornea).

The tunics are adherent to each other, and most altered at and near the most prominent part of the staphyloma. On minute examination, frequently no vessels or nerves are found.

Of the retina, if implicated, only the fibres of the framework, forming large irregular meshes, may be left. In less staphylomatous portions of the retina only the ganglionic cells may be missing.

The choroidal pigment (stellate pigment cells) is generally destroyed, or appears very pale. The hexagonal cells are either absent, or have lost their characteristic shape. Their pigment granules may be present. Their place is occasionally found occupied by transparent globules.

Severe pain, with intolerance of light, and fiery circles, trouble the patient while the equatorial staphyloma is increasing rapidly. Its progress is, however, generally slow, and sometimes accompanied by intermittent dull pain, and by attacks of "ophthalmia."

Vision varies according to the locality and complications of the staphyloma.

Large ciliary or posterior staphylomata admit of excellent sight, while with equatorial staphylomata there may be none, or bare perception of light.

CAUSES.

Injuries.—A blow may rupture the choroid and retina, and leave the sclerotic intact, and some time after may be followed by staphyloma of the corresponding portion of the sclerotic. Sclerotic staphyloma from injury occurs more frequently in the ciliary region. Loss of substance of the sclerotic, from wounds or ulcers, may be followed by staphyloma, not only of the cicatrix, but also of some of the adjoining sclerotic.

Inflammation of several or of all the Tunics, mostly of Syphilitic Origin.—Circumscribed portions of the ciliary region are often occasionally involved; portions of conjunctiva, subconjunctival tissues, and sclerotic, appearing vascular and swollen, and gradually becoming staphylomatous.

Treatment.—Attacks of inflammation or pain, caused by the staphyloma, or the wish to obviate or remove sympathetic irritation of the fellow-eye, or the improvement of personal appearance, may render an operation necessary.

Excision of the eye is the quickest and safest treatment, and should be recommended to poor persons, where the loss of time is of consequence. Iridectomy should previously be tried, if the external appearance of the eye is satisfactory. Abscission succeeds best in sclerotic staphyloma following purulent ophthalmia. The removal of iris and lens has, in some cases, been attended with good results.

Treatment.—The observation that suppuration of the vitreous substance and choroid leads to shrinking of the eyeball, has led to the treatment of drawing a silk thread through the tunics of the eye, and through the vitreous chamber. The silk thread is inserted a little behind the insertion of the inner and outer recti muscles, and is left until well-marked chemosis is produced, when it is withdrawn. The eye gradually shrinks, and, as in abscission, admits of the insertion of an artificial eye of most natural appearance.

ABSCISSION OF THE EYEBALL.

The object of the operation of abscission is the removal of those parts of the eyeball which are situated in front of the ocular insertion of the recti muscles.

Instruments.—Stop-speculum, forceps, cataract-knife, a pair of blunt-pointed scissors. Three strong, slightly-curved needles, armed with fine silk or silver wire.

Operation.—The patient is placed for excision, and brought thoroughly under the influence of chloroform. The lids are kept open by the stop-speculum to expose the eye sufficiently without pressing upon it. With forceps and scissors the conjunctiva is separated from the sclerotic, as far backward as the insertion of the recti muscles.

The curved needles are then passed through the sclerotic and the other tunics, and through the vitreous chamber; partly to prevent the contents of the latter from escaping, partly to facilitate the union of the cut edges of the tunics.

The first needle is introduced just in front of the insertion of the recti muscle, then carried across the interior of the eye, and brought out in front of the insertion of the inner recti muscle. The second needle is inserted about $\frac{1}{8}$ inch above, and the third at the same distance below the first one.

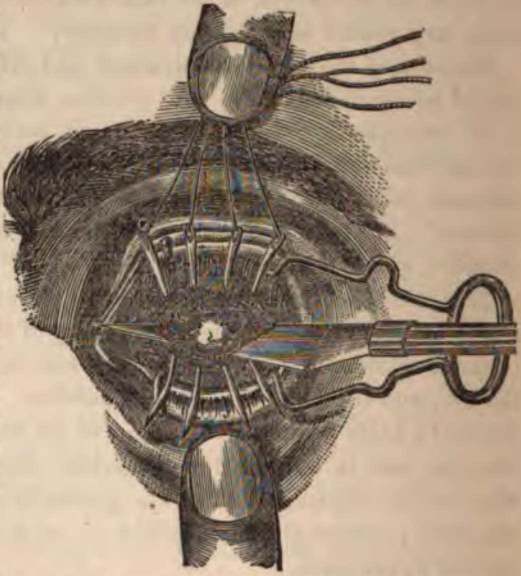


Fig. 19 represents the operation for abscission.

Some difficulty is often experienced in bringing out the point of the needle at the spot intended. Attention to the direction of the curvature of the needle will assist in giving the point the right direction.

The needles having been inserted, we remove the part of the eye situated in front of them. The point of a cataract-knife is thrust through the tunics into the vitreous chamber, just in front of the insertion of the upper rectus muscle.

Through this opening one blade of the scissors is introduced, the other passing along the outer surface of the sclerotic. The rest of the incision is completed with scissors. The vitreous substance in front of the needles is removed last.

The incision being carried through all the tunics (from the insertion of the upper rectus along the points from which the needles project to a spot just in front of the insertion of the inferior rectus muscle), has a somewhat elliptical form, which facilitates union. The middle needle is drawn through first and the suture tied, then the upper needle, and last the lower one.

Lint, dipped in cold water, is tied over the closed lids, so as to cause some pressure until straining and sickness are no longer likely to occur. The bandage is then removed, wet lint applied frequently, and the patient kept in bed for several days.

The operation for excision may subsequently have to be performed, if the pain or sympathetic irritation do not subside, or if they result from suppuration in the stump. Poultices applied over the lids of the eye operated upon, and the treatment of the sympathetic irritation by atropia, should be tried previous to excision.

The latter operation has become necessary, in some cases, months after abscission, through secondary changes in the abscised eye, or through sympathetic affection of the other.

Abscission, instead of excision, has been found most effectual in cases of staphyloma following purulent ophthalmia.

SHRINKING OF THE EYEBALL, AFTER INSERTION OF A SETON.

A stout silk thread is drawn through the tunics of the eye, and through the vitreous chamber just in front of the insertion of the outer and inner recti muscles. The silk is withdrawn as soon as chemosis, with impeded mobility of the eye, shows itself. The eye is left to shrink. The artificial eye is inserted as soon as the conjunctiva has resumed its natural appearance.

This mode of reducing the size of an eyeball has been recommended, instead of incision, for very large staphylomatous eyes.

EXCISION (ENUCLEATION) OF THE EYEBALL.

The operation of incision is indicated—

(1.) If vision of one eye is lost, and if "sympathetic changes" appear in the fellow-eye. If an eye is blind and painful in itself, from whatever cause vision may have been lost. If we suspect the eye to enclose some foreign substance which cannot otherwise be removed.

(2.) In cancer of the eyeball.

The object of incision is to remove the eyeball, and as little of the conjunctiva, muscles, and optic nerve, as possible.

Excision has this advantage over abscission—that it speedily and permanently removes the inconvenience caused by the eye. This, in poor persons, where time is of consequence, may be important. Excision is a less difficult operation, and admits of early insertion of an artificial eye.

Excision may have to be performed on a previously abscised eye, if suppuration or sympathetic changes set in.

Difficulties during the operation may arise from the shape of the eye.

The tunics in shrunken eyes are generally uneven, and furrowed behind the ocular insertions of the recti muscles; and the surface of the sclerotic is not unfrequently adherent to the soft parts of the orbit, so that the palpebral aperture may have to be enlarged for the removal even of a considerably shrunken eye. In ophthalmitis, the solid infiltration of the orbital tissue, which surrounds the sclerotic, renders excision with scissors difficult; and sometimes it has been found easier to remove the eye with the scalpel.

Eyes with ciliary or equatorial staphyloma are often staphylomatous also round the optic nerve. If the latter staphyloma be wounded before dividing the optic nerve, the fluid contents of the vitreous chamber escape, rendering the complete removal of the collapsed eyeball more tedious.

A similar accident may occur if there is deep cupping of the optic disc. By dividing the nerve close to the sclerotic, the deepest part of the cup, reaching beyond the level of the outer surface of the sclerotic, is opened.

Ulcers of the cornea, or very thin staphylomata, may become ruptured during the operation.

In cases of tumors, especially of cancer, we should carefully separate *all* the muscles *before* dividing the optic nerve. The eyeball should be rotated in various directions, to expose the surface of the sclerotic and any tumors that may be found attached to it. The optic nerve is then divided at some distance, say a quarter of an inch, from the eye, so as not to leave any of the cancerous tumor. The cavity of the orbit should at once be examined, and portions of tumors, that may be found behind the eyeball, should be removed.

OPERATION.

Instruments Required:—A strong wire speculum, a forceps, a strabismus hook, and a blunt-pointed pair of scissors, with curved blades.

The operation may be performed, without chloroform, in from one to three minutes. Chloroform should be given if the patient desires it, or if the operation is likely to be prolonged by adhesions, or by alterations of shape of the eye.

The patient, lying on a couch, has the eyelids kept open with the wire speculum. With scissors an incision is carried through the conjunctiva, close to and all round the margin of the cornea. The conjunctiva and subconjunctival tissue are then separated from the sclerotic up to the insertion of the tendons of the recti muscles, and these are divided close to their insertion. The insertion of the inner rectus muscle is divided last, and in such a manner that a small portion of the tendon is left attached to the eyeball, to be used for easier rotation and control of the eye, while dividing the optic nerve, oblique muscles, etc.

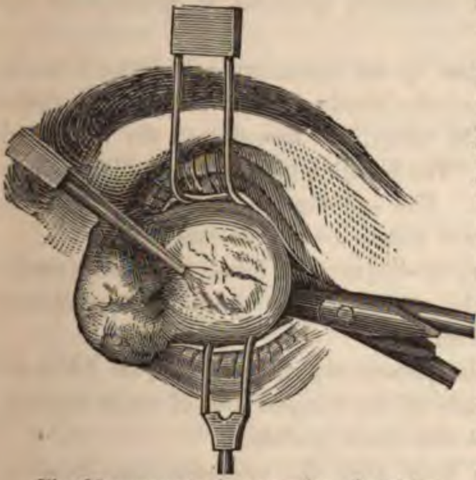


Fig. 20 represents the operation of excision.

After having divided all adhesions between the soft parts of the orbit and the eyeball except the optic nerve, and perhaps the oblique muscles, we gently press the speculum, together with the margin of the lids, backwards over the equator of the eyeball. This causes the latter suddenly to slip in front of the eyelids and speculum. We then firmly grasp the part of the tendon of the internal rectus muscle, which was left attached to the sclerotic, rotate the eye outwards, and introduce the curved scissors closed, and glide them along the sclerotic up to the optic nerve. By lateral movements of the closed scissors, the exact position of the nerve is ascertained. Having felt it, we withdraw the scissors a little, open them, push them on again, and divide the nerve. This done, the eyeball readily escapes at once, provided the oblique muscles and all other adhesions have been previously separated. The somewhat copious bleeding, which follows, lasts for a few minutes. The blood may in part escape into the orbital tissue, and cause much swelling and protrusion of the eyelids, if the eyeball has not been thoroughly freed from all adhesions previous to division of the optic nerve.

The lids are kept open by the speculum, cold water is made to run into the orbit until the bleeding ceases; or several pieces of lint, dipped into cold water, are forced into the orbit and secured by a bandage. The bleeding generally subsides in from ten to fifteen minutes. The speculum and lint are then removed, and a piece of wet lint tied over the closed lids.

Blood escapes into the subconjunctival tissue, and causes swelling and suffusion of the eyelids, if the speculum be removed while the blood flows freely.

The suffused blood disappears rapidly (within from 24 to 48 hours) if a poultice, made of the scraped root of black bryony, is repeatedly applied to the closed eyelids.

If, a quarter of an hour after the operation, the bleeding still continues profusely, as may often occur after the removal of large tumors of the eyeball, it should be arrested by "plugging" the orbit (the lids being kept open by the speculum) with small balls of wadding soaked with the tincture of perchloride of iron. The wadding is kept in place by a bandage.

The bandage and speculum are removed 24 hours later, while the wadding is left to be expelled spontaneously by suppuration. Suppuration appears in from three to five days after the operation.

An artificial eye is inserted as soon as the eyelids and conjunctiva have assumed their natural appearance.

THE CONJUNCTIVA.

GENERAL AND ANATOMICAL REMARKS.

We distinguish an ocular and a palpebral portion of the conjunctiva and the fornix which connects the two. The small fold which projects from the fornix at the inner canthus is termed the semilunar fold. In front of this is situated the caruncle, which consists of sebaceous and hair follicles.

The conjunctiva is firmly attached to the tarsi. Along their inner edges it is very thin, and consists almost entirely of small papillæ and connective tissue. The papillæ resemble those of the adjoining skin.

Near the cornea the conjunctiva is in closest contact with the sclerotic. Its epithelium is continued over the surface of the cornea.

Unstriped muscular fibres have been found beneath the conjunctiva, and the dilation of the pupil, so common in catarrhal ophthalmia, is looked upon as the result of reflex action caused by the irritation of their nerves.

The further from the tarsus, the looser is the attachment of the conjunctiva. The free movement of the eyeball becomes impaired in cases in which the loose conjunctiva of the fornix is more or less destroyed, as happens in severe granular ophthalmia.

In childhood, the ocular conjunctiva is almost transparent. With advancing age, it becomes somewhat opaque, and blood-vessels appear in it. These vessels anastomose freely with those of the palpebral conjunctiva.

The vessels of the subconjunctival tissue are supplied by the ophthalmic artery, and anastomose freely with those of the anterior of the eye.

Many morbid changes of the orbit, and of the anterior of the eye, cause overfulness of these vessels.

At the fornix, the vessels of the conjunctiva anastomose with those of the lachrymal apparatus, and with those of the eyelid.

The fifth nerve supplies the conjunctiva, sending, however, more nerve-filaments into the palpebral portion.

The papillæ of the tarsal conjunctiva are small and cylindrical, and, when swollen, give to its surface a velvety appearance.

In the fornix they are large and mushroom-shaped, though not so numerous as in the part of the conjunctiva between the fornix and the nearest margin of the tarsus. It is the clear, viscid mucus secreted by the papillæ, which chiefly lubricates the surface of the cornea. The epithelial cells of the conjunctiva are continually and rapidly changing. The superficial ones are flat and polygonal; the deeper ones are rounded or oval.

EXAMINATION.

For the examination of the conjunctiva, the patient is seated, and rests his head against the chest of the surgeon, who stands behind.

The conjunctiva of the lower eyelid is brought into view by placing the thumb upon the skin of the lower lid, depressing it towards the margin of the orbit so as to evert the lid, and then directing the patient "to look up."

The conjunctiva of the upper lid may be examined in the following manner:—A probe is placed across the skin of the upper lid, about half an inch from its margin, and the lid is persistently and gently pressed upon. At the same time we seize some of the eyelashes, or a fold of skin near the margin of the lid, and draw the lid a little away from the eyeball, and then upwards. The upper margin of the tarsus being gently pressed upon by the probe, is made to glide along the curvature of the eyeball. This manœuvre causes the upper lid to become everted; and when the patient looks down, the conjunctiva and the greater part of the fornix are brought into view.

The eyelid may be everted by a practised hand without using a probe. To accomplish this, the thumb is pressed upon the middle of the upper margin of the tarsus, and the margin of the lid is thus caused to stand away from the eyeball.

The tip of the first finger of the same hand is then placed between the eyeball and the margin of the lid. Then, while continuous and gentle pressure is made with the thumb, the upper margin of the tarsus is caused to glide along the curvature of the eyeball, and the lid, held between the finger and the nearest part of the thumb, is readily everted. This mode of everting the upper lid, if properly performed, causes no pain, and should be frequently practised, inasmuch as it is required in numerous changes of the cornea and conjunctiva.

Lateral illumination, and the binocular microscope, with a low power and reflected light, have rendered great service in minute examination of many morbid changes of the conjunctiva in the living body.

DEVELOPMENT.

The space behind the folds, which represent the first traces of the eyelids, is occupied by tissue, out of which, among other parts, the conjunctiva becomes developed. The conjunctiva is fully formed about the third month. About the fifth month the margins of the eyelids are adherent to each other, and the conjunctiva forms a closed bag, which contains some clear fluid.

CONGENITAL ANOMALIES.

Absence of one caruncle, and a caruncle with long hairs of the color of those of the eyebrows projecting from it, have been observed.

Tumors of several kinds have been found at birth.

In extreme hypermetropia, the eyeball being very small, a recess of the conjunctiva is often met with at the outer canthus, especially when the eyes converge.

TUMORS.

Warts and other dermoid tumors are occasionally found attached to the sclerotic.

Pinguicula is the name given to an opaque, yellowish-white, roundish, somewhat bobulated substance, about the size of a hemp-seed, situated beneath the conjunctiva, near the outer and inner margin of the cornea, and surrounded by a few enlarged bloodvessels. It resembles a small accumulation of fat beneath the conjunctiva of the fornix, at, or below, the outer canthus.

The fat is intimately adherent to the conjunctiva, extends backwards into the orbit, and frequently causes the fornix of the conjunctiva to bulge.

It is observed in children. Some believe it to be the fat of the orbit, causing the conjunctiva to protrude at a congenitally weak portion of the attachment of the eyeball to the margin of the orbit.

If small, and not increasing, it is best left alone. To remove it, we give chloroform, and make an incision circumscribing the most prominent part of the tumor.

A wedge-shaped portion (the base towards the conjunctiva) is removed, together with the firmly adherent conjunctiva. The wound is carefully closed by sutures. Cold applications and rest of both eyes for ten or fifteen days are required.

Brown or black pigment spots in the conjunctiva, where it joins the margin of the cornea, are, in dark persons, of common occurrence.

Nævus has been observed upon the caruncle, and in the ocular and palpebral conjunctiva. It must, if enlarging rapidly, be excised, or be destroyed by the galvanic current.

The compressorium forceps, to prevent bleeding during the operation, should be applied in cases in which the nævus is situated in the palpebral conjunctiva.

Polypi have been removed from the caruncle and from the semilunar fold.

Cysticercus.—A patient lately attended at the Eye Infirmary, from whose ocular conjunctiva was removed a semi-transparent vesicle about the size of a pea. It was situated in the subconjunctival tissue, near the inner and lower margin of the cornea.

At one spot it was adherent to the slightly vascular conjunctiva. It had only recently been observed, and was becoming larger. Some yellowish fluid escaped on incision of the conjunctiva near it. The entire vesicle was removed. On opening the vesicle, some fluid escaped, in which were found the head and nooklets of a cysticercus.

Pephigus has occurred in the conjunctiva of both eyes simultaneously. The vesicles were of the size of large peas, and filled with turbid fluid: the conjunctiva round the base of each vesicle was inflamed. After some months, numerous adhesions had formed between the ocular and palpebral conjunctiva, together with pterygium like bands encroaching from the ocular conjunctiva upon the cornea.

Epithelial cancer has occurred primarily in the ocular conjunctiva, in the form of infiltration, with an irregular, dry surface. It has been found to consist, microscopically, of an agglomeration of epithelial structure with connective tissue. The veins of the surrounding tissue, in such cases, have been enlarged.

Melanotic cancer, in the shape of freely-movable nodules, not unfrequently occurs in the ocular conjunctiva.

Medullary cancer has not yet been observed primarily.

THE LACHRYMAL ORGANS.

ANATOMICAL AND GENERAL REMARKS.

The Tears.—The fluid which moistens the surfaces of the cornea and conjunctiva is secreted partly by the lachrymal gland, and partly by the conjunctiva itself, but principally by the latter. The secretion of the lachrymal gland, under ordinary circumstances, contributes very little towards the moistening of the cornea.

The surface of the eye continues moist after complete removal of the lachrymal gland. The greater importance of the secretion of the conjunctiva is thus shown.

The tears, while passing over the cornea and conjunctiva, mix with the secretion (epithelium, etc.) of these surfaces. The tears only flow during unusual excitement of the nerves; and if secreted in too great quantity, irritate the eye. Pure tears are freely alkaline, and have a saltish taste. Their specific gravity at 68° Fahr. is 1.0056. One hundred parts contain 98.223 water, 0.504 albumen, 0.016 salts (carbonate, sulphate, and phosphate of lime and magnesia, chloride of sodium), and traces of fat.

The tears are pressed on towards the lachrymal puncta by the act of winking. The more frequently this act is performed, the more quickly the tears are carried off.

MORBID CHANGES OF THE LACHRYMAL ORGANS.

THE LACHRYMAL GLAND.

Enlargement of one lachrymal gland, or of both, rarely occurs. The presence of a tumor in or near the situation of the gland may lead us to suspect the gland to be the seat of the tumor.

Enlargement of the gland, or some tumor near it, together with accumulation of blood in the orbit, may cause considerable protrusion of the eyeball. When chronic enlargement of the gland causes displacement of the eyeball, with impairment of vision, the removal of the gland is necessary.

A preparation in the Eye Infirmary, Moorfield, shows adhesion of an enlarged lachrymal gland to the nearest part of the sclerotic. In this gland a cyst was found, which communicated with the interior of the eyeball. Enlargements of the cells of the gland, and albuminous fluid within the cyst, were discovered on minute examination. In cases of morbid changes in the gland, lachrymation is the exception.

A short time ago a patient attended at the Eye Infirmary, suffering from sudden and simultaneous enlargement of both lachrymal glands. They were painful to the touch, and about three times the usual size, but of good shape. They resumed their normal appearance in about three weeks, under the administration of iodide of potassium.

Swelling of the gland and of the adjoining portion of the eyelid is sometimes observed after operation in the neighborhood. Shrinking of the gland, abscesses, caries of the adjoining bones, protrusion of the eyeball, with suppuration of the cornea, or of the entire eye, and fistula, have followed inflammation of the gland. Cancer and syphilitic enlargement have occurred.

Cysts in the lachrymal gland, or in one of the ducts passing from the gland to the fornix of the conjunctiva, so-called Dacryops, and fistula of the gland, or one of its ducts (Dacryops fistulosus).

This affection may be congenital. Obstructions of the ducts of the gland, in consequence of abscesses, wounds, or operations in the neighborhood, have given rise to the formation of cysts. In such cases, the cyst has formed a small elastic tumor beneath the outer and upper part of the upper lid, which, on shedding tears, has suddenly become larger. The cyst may attain a large size and extend backwards along the eyeball, with the movements of which it may interfere; or it may cause protrusion of the eye.

Treatment.—The thinness of the walls of the cyst generally renders the entire removal difficult. If opened through the skin, a fistula may remain. The best plan is to establish a permanent fistulous opening upon the adjoining conjunctiva.

FISTULA OF THE LACHRYMAL GLAND.

A fistula of this gland, or of one of its ducts, is recognized by oozing of tears from a small aperture in the skin of the upper lid, near the outer canthus. If there be a cyst communicating with the fistula, it can often be emptied by pressing it against the outer border of the orbit.

Sometimes the fistula opens on the conjunctiva, and on everting the lid a small bluish cyst may be seen near it. This opening may become closed accidentally, and numerous attacks of ophthalmia, with chemosis near the outer canthus, or an abscess and swelling of the lids, may appear. The symptoms subside if the fistula opens again.

Such a fistula has been known to exist for nineteen years. It annoys the eye, and wind and dust give rise to excessive secretion of tears.

Treatment.—A fistulous opening should be established through the adjoining conjunctiva, and the fistula in the skin afterwards closed.

THE LACHRYMAL CARUNCLE.

A small red tumor, attached by a pedicle to the surface of the caruncle, has been removed by operation. It consisted of caudate cells and connective tissue; the caruncle itself was healthy.

In another case, a tumor resembling in structure the Meibomian glands, was removed. This was attached to the caruncle by a broad base, and was usually red and slightly uneven, with minute yellow dots (the orifices of the ducts of the glands). It had fine hairs projecting from its surface.

INFLAMMATION OF THE LACHRYMAL SAC.

From some cause or other, acute inflammation may appear in the region of the lachrymal sac. Sometimes, but less frequently, both sacs are simultaneously affected.

General illness, syphilis, disease of the surrounding bones, erysipelas, pus from the conjunctiva, morbid changes in the mucous membrane of adjoining cavities, and chronic morbid changes of the sac itself, may give rise to the affection.

An abscess in the neighborhood of the lachrymal sac, simulating inflammation of the sac itself, is termed ANCHYLOPS before, and ÆGILOPS after, perforation has occurred.

An early symptom of inflammation of the lachrymal sac is the appearance of a hard red, generally very painful, ill-defined, and sometimes erysipelatous swelling in the region of the sac. It is in few cases only that the hard, inflamed sac can be felt through the skin as a well-defined tumor. The swelling forms rapidly. Headache and general feverishness may precede it. The eyelids are more or less swollen and red, sometimes so much so as to prevent their being raised. Dryness of the corresponding side of the nose, or clear discharge from the nose, may be present. The inflammation rarely passes off without disturbing the functions of the lachrymal passages.

On pressing on the acutely-inflamed sac, little or nothing escapes. As the inflammation and the swelling of the mucous membrane decrease, pus appears in the puncta on pressure, or through a fistulous opening. The acute inflammation reaches its height in the course of a few days. If an abscess forms, it perforates the skin, as a rule, just below the internal palpebral ligament. A fistula, termed fistula of the lachrymal sac, often remains, through which pus, mucus, or tears may escape.

With or without such a fistula, there may remain purulent or mucous discharge from the sac, and chronic inflammation with strictures in different parts of the lachrymal passages.

Treatment.—The general treatment depends upon the cause of the inflammation, and upon the health of the patient.

At the outset of the inflammation, we apply one or two leeches to the skin over the sac, and afterwards pieces of lint dipped in cold water. If the lids and the skin over the sac are already swollen, fomentations with hot water, or with hot poppy-head lotion, during the day, and a poultice over the inflamed sac at night, are indicated. If fluctuation is felt, a small incision may be made into the most prominent part of the swelling, to allow the pus to escape; the incision is kept open by occasionally passing a blunt probe into it.

Hot fomentations are repeated frequently, and the patient is ordered occasionally to press gently on the swelling, so as to cause any pus, which may have accumulated, to flow out. As the pain, swelling, and redness of the skin subside, the fomentations may be applied less frequently.

Surgical treatment of the consequences of acute inflammation of the sac may be adopted as soon as the redness and swelling of the parts surrounding the sac have nearly subsided. Eight or ten weeks may elapse before fistula, strictures, etc., can be attended to. It is well to give nature full time to repair the effects of the inflammation before resorting to operative interference.

After an abscess of the sac has emptied itself, diseased bone must be carefully searched for. If any be found, frequent injections of cold water, or stimulating lotions (of iodine, sulphate of zinc, etc.), must be used, and continue until no more diseased bone remains. Such injections are best made by the patient, who should be taught how to pass the nozzle of the syringe through the insertion, or fistulous opening.

Perseverance in injecting warm water, followed by astringent solutions, may restore the permeability of the lachrymal sac without requiring the use of the probe.

OZÆNA, *i.e.*, fetid mucus, or purulent discharge from the nostrils, with or without escape of particles of bone, is sometimes complicated with fistula of the lachrymal sac; the fistula, in such cases, frequently communicating with the nasal cavity.

Periostitis alone, or caries, may be the cause.

Fistulous openings, with the surrounding skin flabby and dull red, and with fetid discharge, may exist near the lachrymal sac, without communicating with its anterior. Chronic syphilitic affections of the mucous membrane of the nose are often the original cause.

Treatment.—Frequent injections, into the nasal cavity and lachrymal sac, of lotio aluminus and mur. ammon., equal parts, alternating with injections of infusion of chamomile flowers, have sufficed to cure some cases; others have recovered after the removal of polypi.

Appropriate antiphlogistic treatment is required in most instances.

DISTENSION OF THE LACHRYMAL SAC.

Discharge from the Lachrymal Sac.—Tumors of the Lachrymal Sac.—(Blennhorrœa.)

In a case of epiphora, we must ascertain, by pressure upon the skin with the finger, whether the lachrymal sac contains mucus, pus, etc.

The distension of the sac may be caused by tears, by clear viscid mucus (mucocele), by muco-pus, pus, blood, or decomposed blood (a dark-brown fluid, containing dark-red and orange-colored crystals).

The distension first affects the anterior wall, and readily occurs, if the nasal orifice of the sac is closed, or not sufficiently permeable.

The morbid contents of the sac sometimes change in character—*e.g.*, during ill-health. A more watery discharge may thus become persistent.

The enlargement of the sac varies in degree. The distended sac often appears as a small roundish tumor, situated behind, and below the internal palpebral ligament. Sometimes it is adherent to the skin. When pressed upon, mucus, etc., escapes, generally through one or both lachrymal puncta, or through a fistulous opening, but seldom through the nasal duct.

When the disease appears slowly, the patient's attention is drawn to it by the tumor, or the discharge, or by the obscuration of vision, or by the epiphora, or by the tenderness and redness of the adjoining skin. During hot weather the enlargement may be hardly perceptible.

External circumstances, inducing catarrhal ophthalmia, readily cause the discharge to reappear; and, *vice versa*, the discharge escaping from the sac upon the conjunctiva sometimes gives rise to blepharitis and catarrhal ophthalmia.

Occasionally, attacks of inflammation occur in the parts around the distended sac.

The discharge is frequently attributed by the patient to a preceding acute inflammation of the sac. The more common causes of the discharge are stricture or complete closure of various parts of the lachrymal passages (with or without fistula), polypi, morbid changes of the mucous membrane of the nose, and granular ophthalmia.

Treatment.—Spontaneous recoveries have occurred. Generally, however, if not treated, the discharge continues for life; and is sometimes associated with great enlargement of the sac, and absorption of the adjoining bones. The enlarged sac may open into the nasal cavity; in which case, there may be emphysema of the surrounding parts. Numerous strictures, or even complete closure of parts of the lachrymal passages, caries of the adjoining bones, and chalky deposits in the lachrymal passages, have been observed to follow.

In cases of discharge without much dilation, both canaliculi, or at least the one through which the discharge escapes when pressure is made upon the sac, should be thoroughly slit open. If the sac is much dilated, and its walls are flabby, both canaliculi are laid open, together with the adjoining portion of the sac. For several days a probe is passed, to prevent reunion of the edges of the incision.

The patient is directed to empty the sac frequently by pressure. In doing this, care should be taken to compress the sac in a direction from the eyeball towards the nose, so as to cause the discharge to escape as much as possible by the nasal duct. The orifice of the duct is generally narrowed or closed, but the discharge having an easy escape through the slit-open canaliculi, and the tears better access to the sac, the causes of the closure of the nasal orifice (thickening of the periosteum, mucous membrane, etc.) frequently subside. The walls of the sac become contracted, the discharge changes from pus to mucus, and then to clear fluid, until at least it ceases altogether, and then the tears pass off by the proper channel.

If the discharge should not have changed its character within from three to six weeks after slitting open the canaliculi, nor have escaped through the nasal duct, the treatment for stricture of the nasal duct must be adopted. Some recommend injections of warm water once a day, to wash out the sac, to be followed by injections of lotio aluminus, and mur. ammon., equal parts (grs. viij ad aquæ ℥j). Such injections are expected to alter the morbid condition of the mucous membrane.

If there be much transparent, viscid mucus, or much swelling of the mucous membrene of the sac, with purulent discharge, as it is observed in cases of granular ophthalmia, a solution of sulphate of copper, grs. 10–20, and 2 grains of morphine (ad aquæ ℥j), is used for injection.

Careful examination into the causes of the discharge, and appropriate general medical treatment, materially assist, and sometimes succeed in curing the patient, even without local treatment becoming necessary.

EPIPHORA. (*Watering of the Eye.*)

Inflammatory changes, especially of the surface of the cornea and conjunctiva, as also some of the morbid changes of the interior of the eye, are frequently accompanied by profuse secretion of tears. Such a condition is called "lachrymation." The term "epiphora" is used when the overflow of tears appears with morbid changes, obstruction, displacement, etc., of the lachrymal passages. The lachrymal accompanying some forms of ophthalmia is due to reflex irritation of the lachrymal nerves. Hardly any lachrymation accompanies inflammation of an anæsthetic cornea. Too great a quantity of tears is in itself a cause of irritation to the mucous membranes.

Epiphora is one of the first symptoms of paralysis, paresis of the orbicularis muscle, and appears before changes in the position of the lids or lachrymal puncta become manifest.

In a case of paralysis of the third, fourth, fifth, sixth, and seventh nerves, the tears accumulated in the inner canthus, and were not carried off; irritation of the eyes resulted. Mental emotions, in this case, did not cause secretion of tears.

Epiphora usually arises either from impermeability, or from displacement of the tear-puncta. A tear-punctum, when displaced and turned away from the eyeball (everted), often appears dry. Morbid changes of the margins of the lids (chronic blepharitis,—in old persons, a relaxed state of the muscles of the lids, etc.) are the most frequent causes of eversion. Swelling around the puncta (their edges being red and turgid), from injury or from inflammation of adjoining parts (during granular ophthalmia, etc.), frequently causes them to become enlarged at first, and subsequently to shrink, or to become strictured, or completely closed.

Foreign bodies (eyelashes, etc.) have been met with in the puncta or canaliculi, causing repeated slight attacks of ophthalmia, and a pricking sensation about the inner canthus, with epiphora. Sometimes an eyelash may be seen projecting from the punctum, and may be readily withdrawn; at other times the punctum and canaliculus require slitting open before the eyelash can be removed.

Epiphora generally precedes, and for a considerable time accompanies, obstructions and other morbid changes of the lachrymal passages.

Other causes of epiphora are stricture or closure of the canaliculi through injury, sebaceous tumors, fungi, or chalky concretions, or through spontaneous inflammation, ulceration, or morbid changes in the follicles.

Shrinking of the eyeball may produce epiphora, by depriving the muscles which act upon the lachrymal passages of their support.

The epiphora varies in degree in the same case at different times, and is worst when the eyes are exposed to the wind. There may be none during a warm, dry season.

Lachrymation often causes eczema along the margins of the lids: not so epiphora.

Treatment.—Lachrymation subsides if the morbid changes of the cornea, etc., which give rise to it, are properly treated. Displacement or obstruction of the lachrymal puncta and passages must be attended to, whatever be the cause of the lachrymation.

In all cases of epiphora, we must examine the state of the lachrymal passages. To do this, a knowledge is required of the method of passing probes, and of injecting fluid into the passages, and of the operation of slitting open the tear-puncta and canaliculi.

Water should be injected previously to, and a few days after, the operation of slitting open the puncta. If the injection does not pass, probing of the passages is required, and the case is treated as one of stricture. This may be complicated with fistula, or with discharge from the sac.

The operation should always be done during anæsthesia. When the patient has been properly placed, and the lids fixed by an assistant or a spring speculum, four or five small curved needles should be passed through the cicatrix in a row along the upper and lower border of the staphyloma, and left there. When this has been done, a meridional wound about two lines long is to be made with a knife, just in front of the line of insertion of the internal·rectus muscle.

STRICTURE OR CLOSURE OF THE LACHRYMAL PASSAGES.

This condition is most frequently met with at the spot where the canaliculi join the lachrymal sac, and at the nasal orifice of the sac (commencement of the nasal duct). It rarely occurs in other parts of the passages. Whatever be the cause or duration of the obstruction, if it is complicated with epiphora, or fistula, or discharge from the lachrymal sac, its removal, as a rule, causes these complications to subside.

The situation of the stricture, or closure, is ascertained by passing a probe through the lachrymal passage, after having previously slit open the punctum and the canaliculus of the lower lid. If the stricture, or closure, is situated at the spot at which the canaliculus joins the lachrymal sac, it is necessary to slit open the part of the sac immediately adjoining the canaliculus, and to prevent reunion by passing a probe through the incision into the sac for several days in succession.

Strictures of the nasal duct are treated by slitting open the lower canaliculus, or the one through which the discharge, if there be any, returns from the sac; and by occasionally passing a probe of some size through the canaliculus and nasal duct, and leaving it in for a few minutes.

It generally suffices, when we have once succeeded in passing number six probe, to introduce the probe only when the epiphora becomes troublesome.

If we suspect the obstruction of the nasal duct to be caused by swelling of its lining mucous membrane (*e.g.*, from granulations), slightly astringent injections and the passage of catgut probes (gradually increasing in size) may be tried. For the treatment of stricture of the nasal duct, see treatment of fistula of the lachrymal sac.

"Complete closure" of any portion of the canaliculus is treated by incision with the guarded knife. The edges of the incision are prevented from reuniting by frequently passing a probe.

In complete closure of the nasal duct, a number six probe, introduced into the sac through one of the slit-open canaliculi, is forced into the nasal duct. As long as the probe is pressed on in the right direction, no harm can be done, although much force may be necessary.

FISTULA OF THE LACHRYMAL SAC.

The fistulous opening in the skin, especially if there is no inflammation around it, is small, and sometimes hardly perceptible. Its situation is indicated by the occasional escape of a tear through it, either spontaneously or during pressure upon the sac. It generally lies close to the lower margin of the internal palpebral ligament. Sometimes it is lower down upon the cheek, or even near the outer canthus. Sometimes it is situated in the conjunctiva, or opens into the nasal cavity. As a rule, it is preceded by acute inflammation of the sac. It is sometimes caused by injuries.

Many cases of suppuration of the lachrymal sac, whether followed by spontaneous perforation, or opened by incision, get well without leaving a fistula.

Treatment.—Unless treated, the fistula may continue for life. It is generally complicated with one or several obstructions in the lachrymal passages; and, as a rule, closes spontaneously, if the permeability of these passages is restored. This is usually accomplished by "probing," after having in every case slit open the tear-puncta and canaliculi (one or both), and adjoining portions of the lachrymal sac.

The treatment by probing should be commenced as soon as the swelling of the parts surrounding the canaliculi and tear-puncta admits of easy access to the latter.

Cases in which the skin has been inflamed over the sac, and the lids swollen, have recovered (with closure of the fistula, cessation of the epiphora, and of the discharge from the sac) within a month after the passing of a number six probe into the nasal duct.

When probing, or inserting a style, we must be careful to carry the instrument in the direction which the lachrymal passages take in health; and also to open freely, and to keep open, those parts of the passages through which probes have to pass.

After having slit the canaliculi, we at once try to pass number six probe through the lachrymal passages into the nose. If we succeed, we leave the probe inserted for from ten to fifteen minutes. Laminaria probes expand rapidly through imbibition of fluid, and it may become difficult to withdraw them. We must, therefore, be acquainted with the degree and capacity of their expansion.

After withdrawing the probe gently, we direct the patient to empty the sac frequently by pressure upon the skin round the fistula, and to apply a small linseed-meal poultice to the inflamed part at bedtime. The probing is repeated every second day, and less frequently if the epiphora and discharge decrease. No poultices are required if the skin is not inflamed.

Some recommend the temporary introduction, through the fistula into the nasal duct, of a piece of catgut probe, saturated with nitrate of silver.

One end is left to project through the fistulous opening, while the rest of the probe is introduced into the stricture until it is firmly grasped.

Previous to passing the probe, and its withdrawal, the lachrymal sac should be syringed out with warm water. The probe is left in the stricture for twenty-four hours, and then withdrawn. A fresh one is introduced every day until the nasal duct has reached its proper calibre, and until an injection into the sac passes through the duct into the nose. This result may be attained within a few weeks. If irritation arises, a simple probe is introduced until the symptoms have subsided.

Experience is required as regards the frequency with which the probe should be introduced.

In this, we must be guided by the decrease of the epiphora and discharge. If these become less, especially if the fistula has closed, we discontinue probing; if they reappear, or continue as before, we probe again. Injection of warm water, etc. through the fistulous opening, or through the canaliculi into the sac—if they should have been thought necessary—are discontinued as soon as no more discharge, but only clear fluid, escapes from the sac while injecting.

Though many cases recover by local remedies alone, much benefit may be derived from good medical treatment. The use of arsenic internally, with the local application of mercury, is especially to be recommended.

INJURIES.

Wounds of the skin and other soft parts near the lachrymal passages must be carefully closed, and the parts kept in such position as will contribute most perfectly towards the undisturbed conveyance of the tears.

Fistulous openings in the lachrymal gland, the canaliculi, or the lachrymal sac and nasal duct, may be the result of injury.

Rupture (*e.g.*, of the lower canaliculus), with closure at the seat of injury, may occur. In this case, we pass a properly-bent probe along the upper canaliculus into the lower one. We then slit open both canaliculi along the probe.

Rupture of the lachrymal passages, by blows, etc., followed by emphysema of the surrounding parts, is not an uncommon occurrence. The swelling of the lids in such cases appears when the patient is blowing the nose. It commences at, and spreads from, the inner canthus. A cackling noise is perceived on making pressure upon the swollen lids, or a full sound on percussion. Rest of the parts, avoiding blowing the nose, and slight pressure upon the spot from whence the emphysema commences, must be recommended.

INSTRUMENTS USED IN THE TREATMENT OF LACHRYMAL OBSTRUCTIONS.

Probes.—Three silver probes (known as Bowman's probes), the ends of each being of different sizes (number one being the smallest, number six the largest size).

A conical probe for one tear-punctum, while injecting through the other.

Laminaria, and catgut probes of different sizes.

Laminaria Probes.—These probes are made from the dried stem of the Laminaria digitata. They cannot be passed so readily as silver probes. Through rapid imbibition of moisture, when passed into the lachrymal passages, they swell out considerably. They have been found of use in cases of stricture of long standing. Large probes may be left in from ten to twenty minutes. An indentation in the swollen part of the probe indicates the seat of the stricture. The dilation can be confined to the stricture by covering those parts of the probe which we wish not to become disturbed with copal varnish. With a smaller probe we previously ascertain the seat and extent of the stricture.

Catgut Probes.—One end of the probe is rounded off, and the oily matter washed out with weak liquor potassæ. The part which is to lie in the stricture is dipped into a solution of nitrate of silver (about a drachm to an ounce of distilled water) for from five to ten minutes. The probe is then suspended in a dark place, dried, and kept in a blackened glass tube for use. Some dip the probe into a solution of nitrate of silver (one part to ten parts of distilled water) at the time it is required.

Probes of the size and thickness of Bowman's number six probe, but made of *very flexible metal.* These are converted into styles.

A pair of nippers, with a contrivance for bending the flexible probes.

A director of steel, electro-gilt. One end of its firm stem tapers off, and is grooved to within a line of its extremity: the other end of the stem is stronger; its extremity is also grooved, and slightly curved on the grooved side.

A narrow-bladed *cataract-knife*, for slitting the canaliculi.

A *guarded knife*, in shape like a penknife, for slitting open the puncta, canaliculi, and part of the lachrymal sac.

OPERATIONS.

REMOVAL OF THE LACHRYMAL GLAND.

This operation is somewhat difficult if the gland is healthy; it is accompanied by abundant bleeding. The firm connective tissue and fat surrounding the gland may be mistaken for the gland itself; an acquaintance, therefore, with the appearance of its cut surface, when fresh, is necessary, in order to avoid error.

During the operation, a spatula is placed beneath the upper lid, to protect the eyeball.

An incision about an inch long, and commencing near the outer canthus, is carried through the skin, muscles, and suspensory ligament of the eyelid, along the margin of the orbit, and over the most prominent part of the gland, if the latter be enlarged.

The gland is seized with a pair of forceps, and separated first from the periosteum, and then from the surrounding tissues.

The amount of suppuration following the operation varies in degree. Erysipelas and considerable swelling of the eyelids, with headache, sometimes occur. The patient is kept in bed for from three to five days after the operation, and large pieces of lint dipped in iced water are applied to the wound and surrounding skin. The cicatrix is not conspicuous. The dropping of the upper lid subsides in about seven weeks after the operation. After removal of the gland, the eye feels dry; in windy weather more winking is required, or irritation of the conjunctiva is more prolonged and painful.

OPERATION FOR FISTULA OF THE LACHRYMAL GLAND.

A strong thread of black silk is armed with a needle at either end. Each needle is passed, in turn, along the fistulous canal, to about the nearest point of the conjunctiva above the tarsus of the upper lid, and then thrust through the walls of the fistulous canal and the conjunctiva. The second needle is made to penetrate the conjunctiva about one-sixth of an inch from the first. A small portion of the conjunctiva and of the wall of the fistula are thus enclosed in a loop, the ends of which are brought out at the outer canthus, and with a sticking-plaster secured to the skin of the temple.

If a cyst is present, the needles are passed in a similar manner through the fistulous opening and the canal into the cyst, and then through its walls, and through the nearest conjunctiva.

A few granulations of the conjunctiva round the silk, with some swelling and redness of the lids, must be expected.

About ten days after the introduction of the silk, some of the skin surrounding the orifice of the fistula is removed, and the edges of the wound are united with sutures. About the fourth week the silk is withdrawn, and the portions of the wall of the fistulous canal or of the cyst, as well as of the conjunctiva intervening between the apertures made by the silk, are cut through.

INJECTION OF FLUID INTO THE LACHRYMAL PASSAGES.

To the introduction of the nozzle of a syringe into the puncta and canaliculi, the same rulès apply as to the introduction of probes.

The size of the nozzle required depends on the nature of the fluid to be injected, and upon the calibre of the canaliculi. Fluid, when injected into permeable lachrymal passages, passes through them, and enters the nasal cavity; and, in consequence of the inclination of the floor of the latter, comes backwards into the throat, unless, while injecting, the patient's head is somewhat inclined forwards.

The slightest swelling of the mucous membrane of the lachrymal passages may prevent fluid from passing through. All fluid injected through the lower canaliculus returns through the upper one upon the conjunctiva, if the canaliculi communicate before entering the sac, and the orifice into the sac itself is closed; or if any obstruction exists at the nasal

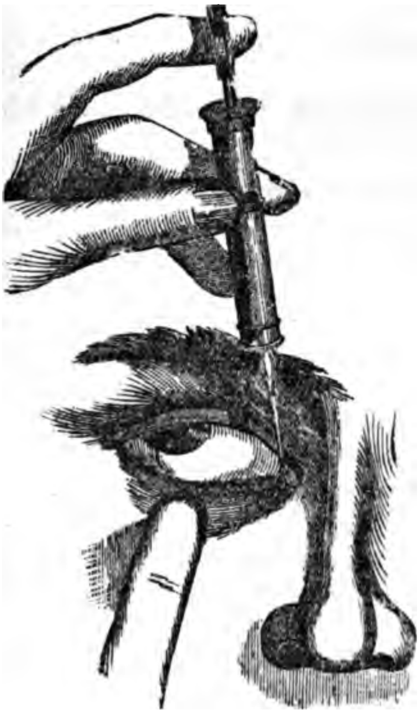


Fig. 21 represents the introduction of the nozzle of a syringe into the puncta.

orifice of the sac. The fluid returns through the canaliculus into which it has been injected if no communication exists between it and the other one, or between it and the sac, or between it and the nasal duct.

While injecting medicated fluids, the upper lachrymal punctum must be kept closed by a conical probe introduced into it, in order to prevent escape of the fluid on to the conjunctiva. The injected fluid readily fills the sac, if the obstruction exists only at the nasal orifice. In such cases, more concentrated fluids may be used.

Injections may render probing unnecessary. They enable us to recognize the seat of obstructions. They are especially used for the purpose of washing out a distended lachrymal sac, or to induce changes in the nature of its secretion.

THE OPERATION OF SLITTING OPEN THE LACHRYMAL PUNCTUM AND CANALICULUS.

Eversion and obliteration of the puncta should be created by slitting up the canaliculi. We will suppose the lower canaliculus of the right eyelid to be the one to be slit up. The surgeon stands behind the patient, whose head he receives and steadies against his breast. He takes one of the minute directors, manufactured for the purpose, with the right hand, and passes it by the punctum through the canaliculus into the lachrymal sac. He then transfers the director to the left hand, holding it with the thumb and fore-finger, while with the middle finger he draws the lower eyelid outwards, so as to put the canaliculus on the stretch. With his right hand he passes a cataract-knife through the punctum, along the groove of the director, and thus slits up the canaliculus to any desired extent. This may be limited in the case of an obstructed or everted punctum; but should the slitting up of the canaliculus be performed as a preliminary step to the introduction of probes into the nasal duct, it must embrace the whole length of the canaliculus, to insure which, the edges of the knife should be raised well up, as it is withdrawn. The knife should not be used until the lid and canaliculus are well secured. The bleeding which follows the operation readily subsides.

Finely-pointed scissors may also be used for incising the canal. Dr. Giraud-Teaulon has invented an instrument which combines in itself the director and cutting-blade (Fig. 22). We find, however, that this instrument is very liable to get out of order, especially from moisture getting into the groove.

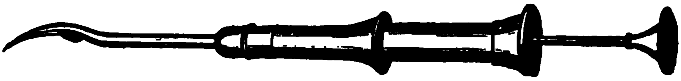


Fig. 22.

Acute inflammation of the sac is treated by leeches and evaporating lotions. If suppuration commences, warm poultices should be substituted for the cold applications. If the abscess point, it should be laid open freely, and the poultices reapplied.

As soon as the acute inflammatory stage is over, the lachrymal passages should be explored by a probe. If there be any obstruction of the nasal duct, endeavors should be made to restore its normal calibre by the systematic introduction of probes.

PROBING THE LACHRYMAL PASSAGES.

Fine probes may be readily passed through the tear-puncta, the canaliculi, the sac, and the nasal duct, without slitting open the puncta.

The canaliculi admit probes of considerable size. Sometimes a difficulty arises from the puncta appearing completely effaced. Their situation at the inner corner of either tarsus, and nearly opposite each other, assists in finding them. These corners become very conspicuous when tilted forwards, while the patient attempts to close the lids. Before passing a probe, the lids, puncta, and canaliculi have to be steadied, as during the operation of slitting open the puncta and canaliculi.

A probe, after having been introduced gently and vertically into the punctum, or slit-open punctum, and canaliculus, is pushed horizontally along the canaliculus until it is arrested by the bony wall of the sac. Then, while pressing the one end of the probe moderately against this wall, the other end is raised along the upper margin of the orbit, until it assumes the (nearly vertical) direction of the nasal duct. The part of the probe which rests against the bony wall of the sac, during this manipulation, glides along that wall, and spontaneously, or on moderate pressure, enters the nasal duct. When the probe is introduced properly, its projecting portion rests against the upper margin of the orbit, near the supraorbi-orbital notch. If this portion of the probe is loose, and stands away from the margin of the orbit, the introduced portion being directed too much backwards, then the lower end of the probe has pierced the lachrymal bone, and has passed behind the nasal duct. This accident is of no consequence if the subsequent probing be carried on in the right direction. We can tell by the extent to which the probe has entered whether it has passed through the entire length of the nasal duct.

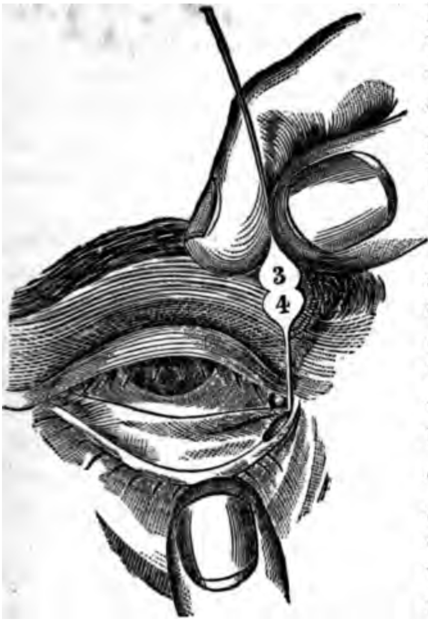


Fig. 23, showing the probe in the tear-punctum.

When examining for stricture, we first slit open, generally, the lower punctum and canaliculi, and immediately after this, introduce a number six probe along the canaliculus, to ascertain its condition. The canaliculus must be kept well stretched while doing this. If there be a stricture, and the probe cannot be passed into the sac, finer probes must be tried. If no probe can be passed, we prevent the incision of the slit-open canaliculus from closing, and wait for from two to three weeks, until all irritation and swelling from the operation have subsided.

The canaliculus is permeable, and the point of the probe is in the lachrymal sac, if the skin over the sac and the palpebral margin remain motionless (the canaliculus being well stretched) while the point of the probe is repeatedly pushed towards the inner bony wall of the sac.

Any resistance encountered by the probe, while passing along the canaliculus, causes the skin beneath the internal palpebral ligament to appear wrinkled. The free margin of the lid, though held on the stretch, also becomes pushed towards the lachrymal sac, when the probe is pressed against the resisting portion of the canaliculus (stricture, etc.) It is important to recognize this movement of the lid, and to estimate its extent. Its existence is a certain sign that the probe has not entered the lachrymal sac. If a fine probe passes, thicker ones will gradually be admitted.

We discontinue probing when number six can be passed; and teach the patient to pass the probe, or do it again themselves, if the epiphora reappears.

With stricture in the canaliculus, others may exist in the nasal duct.

If an injection does not pass through the nasal duct, but the probe enters the sac, we pass it on into the nasal duct. If we do not succeed the first time in doing so, it is well to be satified with keeping open the punctum and canaliculus, and to wait two or three weeks before trying again to pass the probe.

If the epiphora becomes less, or ceases, as often occurs in stricture after the canaliculus has freely laid open, no probe should be passed into the nasal duct. The nasal duct is most easily probed throngh the lower canaliculus; and we hardly ever fail in passing the probe, if we carry it in the direction which the duct occupies in health.

On finding a stricture, which is generally situated at or near the duct orifice of the sac, we use that probe which passes with some difficulty into the stricture. When once number six passes readily, we discontinue probing. We only reintroduce the probe, if, through contraction of the stricture, the epiphora becomes troublesome. Some patients learn to pass the probe themselves. No probe should be passed unless we have a definite curative object in view.

DESTRUCTION OF THE LACHRYMAL SAC.

The cavity of the sac is freely laid open by an incision through the integuments, about three-quarters of an inch in length, commencing just above the internal palpebral ligament, passing outwards and downwards, and running parallel with the nearest portion of the margin of the orbit. If the sac is distended, the incision is carried over its most prominent part. If there is a fistula, it must be slit, and the sac laid open. All discharge is wiped away, and the inner surface of the sac touched with the solid nitrate of silver, or with the actual cautery. The scab formed by the solid nitrate of silver is removed after 48 hours with forceps; this must be done thoroughly and carefully, otherwise tedious suppuration follows. Continuous gentle pressure, until the wound has healed, is made upon the sac by means of lint or wadding, and a bandage. This is taken off twice daily, and the parts are cleansed with warm water. Erysipelas or severe inflammation has, in a few cases, occurred after this mode of cauterization.

In 11 cases of cauterization with the actual cautery, of which notes were kept, no erysipelas or severe inflammation followed.

Irons of a particular shape are used for counter-irritation. The eyeball must be protected by a spatula placed between it and the sac, and the latter must be freely exposed, so as to enable the operator to touch it thoroughly. To avoid bleeding, the white-hot iron only should be used. The pain is slight.

Cold fomentations are applied until the incision is closed. The patient need not remain in bed for more than 24 hours.

Complete destruction (obliteration) of the lachrymal sac has been found beneficial in cases of fistula, in which we have not succeeded in restoring the natural passage for the tears; in cases of extensive disease of the bones round the sac, or of ulcerations within it; of fistulous openings from the lachrymal passages into the nose, and of closure of the nasal duct from cicatrices.

The operation should be preceded by closure of the puncta and canaliculi by cauterization. The tears, if this preliminary step is not taken, find their way towards the sac; and mucous discharge from a newly-formed cavity or fistlua, etc., may again appear.

INSERTION OF A STYLE.

The above method of treating by dilation has found much favor both at home and abroad, and possesses great advantages over the old style, which we now only employ after every other plan of treatment has failed. The treatment of lachrymal stricture by the modern method is as superior to that by the style, as the periodical dilation of a urethral stricture would be to that of the life-long retention of an instrument in the urethra. On the introduction of the method, it shared the common fate of all novelties: it was either rejected *in toto* by those who either could not, or, what is worse, would not recognize its advantages; or, on the other hand, its value was, we believe, overrated by those who adopted it. We have ourselves pursued it from its first appearance; in many instances we have found it easy and efficient; in others it has proved difficult and unsatisfactory in its application. In such cases, the lachrymal sac may be destroyed by caustic or the actual cautery—a procedure which, however apparently illogical in theory, has proved successful in practice.

OBLITERATION OF THE LACHRYMAL SAC

is performed in the following manner:—The sac is opened by a free incision, and thoroughly cleansed. After the bleeding has ceased, the lips of the wound are held apart by Manfredi's speculum, which is provided with a plate to protect the cheek from caustic. The surgeon then freely cauterizes the interior of the sac with a piece of lint steeped in some deliquescent caustic, such as butter of antimony or perchloride of iron, taking care to touch every part of the wall, and especially the lachrymal orifices. The after-treatment consists in iced-water applications for some hours after the operation, till all acute pain has subsided, when they may be replaced by warm poultices. In a few days the slough separates and leaves a granulating surface, which may be dressed with dry lint. A leaden probe must now be introduced through the canaliculus (which should be slit up prior to cauterization) into the nasal duct, and must be there retained until the cicatrization of the wound is complete. By this means the tears will be encouraged to flow in their normal channel, and the external opening will rapidly heal.

After repeated inflammation of the sac, or after ineffectual attempts have been made to cure the disease by the above methods, the style may be tried. An incision is made with a narrow, straight bistoury just below the tendo oculi, which, on drawing the eyelids outwards, may be felt as a rounded cord, passing inwards from the inner canthus.

Fig. 24.

The bistoury is then passed downwards and outwards into the lachrymal sac, and serves as the guide for introducing the style into the sac, after which the bistoury is withdrawn, and the style left in the sac. A silver style (Fig. 25), about 1¼ inch long, with its neck at an obtuse angle to the shaft, and surmounted by a rounded head, is to be passed into the nasal duct. The style should previously be put through a piece of adhesive plaster, to prevent it sinking into the sac.

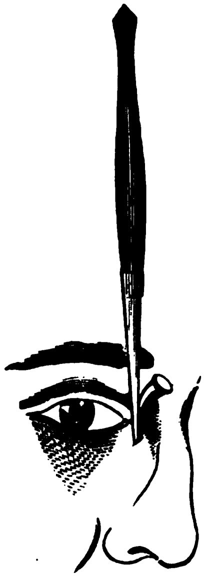


Fig. 25 represents the operation of a style.

Every morning it must be removed and cleansed, and immediately replaced into the nasal duct.

CLOSURE OF THE LACHRYMAL CANALICULI.

Take a silver probe, dip it into pure nitric acid for two or three seconds, and then warm it slightly over the flame of a spirit-lamp. This causes a coating of nitrate of silver to form over the warm part of the probe. Introduce the latter into the canaliculus, and withdraw it after a minute. An adhesive inflammation, causing closure of the canaliculus, is expected to follow.

PTERYGIUM.

The term pterygium is applied to a somewhat triangular-shaped, tolerably well-defined substance, which, movable with the conjunctiva, projects slightly from its surface. It generally occupies the ocular conjunctiva between the cornea and semilunar fold of each eye. As many as four pterygia have been observed in each eye, their apices encroaching upon the cornea (in a direction parallel with the recti muscles), and meeting about its centre. In rare cases, the triangular shape may be lost in consequence of changes in the cornea. The apex of the triangle is situated at the margin of the cornea, or upon it.

In the latter case it appears opaque, and embedded in the cornea.

The base is situated in the ocular conjunctiva, and generally loses itself in the fornix.

The pterygium, microscopically, consists of hypertrophied connective tissue, and of bloodvessels. Its vessels diverge from the apex towards the base, and then anastomose with those of the recti muscles.

If nearly transparent, like the conjunctiva, it is termed *pterygium tenue;* if gray, opaque, and vascular, *pterygium grassum.*

Ulcerations and pustular ophthalmia, followed by hypertrophy of the conjunctiva, are mentioned as causes. But the usual cause is not yet discovered.

Pterygium occurs frequently among sailors, and in young persons living in a hot climate. It causes no pain, but, if very dense in texture, may interfere with some of the movements of the eyeball.

It is not generally noticed until it encroaches upon the cornea and gives rise to impairment of vision.

Treatment.—The patient, if he object to an operation, may be told that, unless the pterygium interfere with "sight," it need not be removed, but that a cure may be effected without an operation, and that the recovery of vision will be slower the longer the removal is postponed.

The frequent recurrence of the pterygium after removal has given rise to various methods of treatment. The transplantation of the apex is the mode generally adopted for fresh cases, as well as for those previously operated upon.

Operation.—The best method is probably the following:—While an assistant holds open the lids, the operator seizes the pterygium near the scleral border with a pair of reliable forceps, draws it away from the globe, and separates the corneal portion from the apex with a pair of scissors curved on the flat (Fig. 26); or, what is to be preferred, enters a pointed bistoury or cataract-knife flat on the sclera, between this and the neck of the pterygium, its cutting edge being directed towards the cornea, and cuts with a gentle course of the knife the corneal portion, extending above the level of the sclerotica, as evenly as possible from its substratum. Then the separated portion of the pterygium is drawn up, and the conjunctiva dissected up with the scissors towards the palpebral fold, one to two lines distant from the corneal margin, keeping exactly to the edges of the pterygium, and close to the surface of the sclerotica.

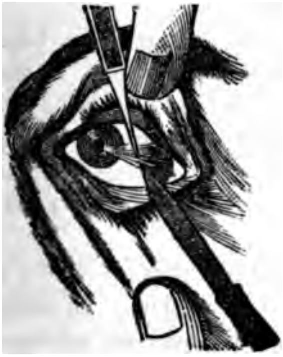


Fig. 26.

The two angles of the wound are then united by two converging incisions, which meet in front of the reflection, and thus enucleate the circumscribed pterygium. The wound is now nearly of a rhomboidal shape. It is not necessary, but rather hurtful, to extend the incision into the reflection; still, we should, as far as possible, include all hypertrophying tissue. In large pterygiums, the wound will then naturally be also very extensive, and it is, in such cases, necessary to unite the gaping edges by some extremely fine suture, after having dissected the affected portion of the ocular conjunctiva to a sufficient extent from its base, in order to enable the edges of the wound to be drawn together without too great stretching. Besides, in order to attain the desired result, we do not need to move completely the rhomboidal portion, or the entire pterygium. It is sufficient to simply throw back the new growth which has been dissected up, and to close the triangular wound by a suture. The pterygium soon shrinks away, and in a short time is unnoticed.

After the operation, rest of the eye is to be secured by the application of a binocular protective bandage, in order that union of the edges be not interfered with.

This bandage should be worn, according to necessity, from three to four days, when the sutures are to be removed. In the mean time, a proper antiphlogistic regimen is to be carried on. If, with the secretion of pus, granulations subsequently form, pencillings of the parts with tincture of opium, having first cut off the prominent fleshy growth, is the best treatment. Cold-water dressings are required.

In consideration of all this, it is scarcely possible to be a very earnest advocate of an operation in pterygium. In small ones, where it accomplishes the result, indications are predominantly of a cosmetic nature.

With the most of those affected with pterygium, these indications do not weigh very heavily. In a large pterygium we can do much less, and the danger is considerably increased. It is well, then in these cases, to avoid an operation; and, in case the vision is considerably affected by covering over of the pupil, we may improve it by iridectomy.

THE EXTERNAL MUSCLES OF THE EYEBALL.

ANATOMICAL AND GENERAL REMARKS.

The external muscles of the eyeball receive their blood from branches of the ophthalmic artery. The blood is carried off by veins which lead, some into the facial, others into the ophthalmic vein. The nutrition of the muscles increases with exercise, and rapidly adapts itself to changes in this respect.

The motor nerves supplying the muscles are the third, fourth, and sixth. These have been traced within the skull as far back as the pons varolii and the medulla oblongata. The nerves pass through the sphenoidal fissure into the orbit; and as they do so, they are nearer together than elsewhere.

The third nerve supplies the levator palpebræ, the internal rectus, the superior and inferior recti, and the inferior oblique (and iris), and, according to some anatomists, also the external rectus. The fourth nerve supplies the superior oblique. The sixth nerve supplies the external rectus.

The tendons of the muscles penetrate the sclerotic, and break up in its middle layers. *The internal rectus muscle* is firmly attached to the periosteum, near the inner margin of the optic foramen, and loosely to the subconjunctival fascia and tissue. It is inserted into the sclerotic about 2½‴ from the margin of the cornea. It is the strongest and largest of the recti muscles, its width being about 4‴.

Function.—It draws the cornea horizontally inwards towards the inner canthus, without altering the inclination of its vertical meridian.

The inferior rectus muscle arises from the periosteum near the lower margin of the optic foramen, and is inserted into the sclerotic about 3‴ from the lower margin of the cornea. The middle of its sclerotic insertion lies about ½‴ to the inner side of the vertical meridian of the cornea.

Function.—If acting alone, it draws the cornea downwards, and slightly inwards, inclining its vertical meridian outwards. Its action is opposed by the "superior oblique," which draws the cornea downwards and outwards, inclining its vertical meridian inwards. Both muscles acting together draw the cornea straight (vertically) downwards.

The superior rectus muscle arises from the periosteum near the upper margin of the optic foramen, and passes forwards and slightly outwards over the sclerotic, into which it is inserted at about 3‴ from the upper margin of the cornea. The line of insertion is not parallel with the margin of the cornea, but somewhat slanting, so that the inner margin of the tendon is about 1‴ nearer the margin of the cornea than the outer.

Function.—When acting alone this muscle moves the cornea upwards and slightly inwards, inclining its vertical meridian inwards. In this it is counteracted by the "inferior oblique," which turns the cornea slightly upwards and outwards. The combined action of both muscles causes the cornea to be drawn straight (vertically) upwards, the vertical meridian of the cornea remaining vertical.

The inferior oblique muscle arises from the periosteum within the orbit near the orbital edge of the superior maxillary bone, close to the outside of the lachrymal sac. It passes backwards and outwards along the floor of the orbit, beneath the inferior rectus, to which it is loosely attached, and then following the curvature of the sclerotic, it becomes inserted into the latter exactly over the yellow spot, and opposite to the insertion of the "superior oblique." Its line of insertion, however, does not run parallel with that of the superior oblique. A needle thrust through the middle of its line of insertion and through the tunics into the eye passes through the centre of the yellow spot.

The branch of the third nerve which supplies the muscle also sends a branch (the motor root) to the ciliary ganglion.

Function.—This muscle rolls the cornea upwards and outwards, and inclines its vertical meridian outwards.

The superior oblique muscle ("the trochlearis") arises from the periosteum, near the inner margin of the optic foramen. It passes forwards towards the inner and upper margin of the orbit. Close to the latter, still within the orbit, is attached a fibro-cartilaginous ring ("the trochlea"), through which a tendinous portion of the muscle glides. Thence the muscle takes a direction outwards and backwards, passes beneath the upper rectus, then becomes broader (about 2''' wide), and is inserted into the sclerotic about 3''' above the yellow spot. The nearest point of the optic nerve where it joins the sclerotic is about 4''' from the nearest point of the insertion of this muscle. It is supplied by the fourth nerve, and, according to some, receives also a branch of the third.

Function.—When acting alone, this muscle rotates the cornea outwards and downwards, and inclines its vertical meridian inwards. If both oblique muscles (the superior and inferior) act forcibly together, they draw the cornea towards the outer canthus. They assist the recti muscles, and rotate the eyeball round an imaginary axis, the anterior pole of which is external to the anterior pole, and the posterior internal to the posterior pole of the eyeball.

The external rectus muscle is a long, narrow muscle, which arises from the periosteum at the outer margin of the optic foramen, and is inserted into the sclerotic about 3½''' from the outer margin of the cornea. It is supplied by the sixth nerve.

Function.—This muscle draws the cornea straight (horizontally) outwards, and does not alter the inclination of its vertical meridian.

Having shortly stated the function of each muscle, it remains to show:—

(1.) What muscles come into play during the combined movements of both eyeballs.

(2.) The means by which the amount of contraction of the muscles during binocular vision may be ascertained.

(3.) The method of demonstrating the changes of position which especially the cornea and retina undergo during movements of one eye, or of both.

Some of the terms made use of in describing these movements refer to the position of the eyes in relation to the head.

Looking up, or moving both eyes upwards, signifies that the visual lines are raised, the cornea approaching the upper margin of the orbits. Fixing an object equidistant from both eyes, or converging the eyes towards an object, implies a convergence of both visual lines towards the median line, etc., etc.

The object of most movements of the eye is to direct the visual line to the point which we wish to see accurately.

In order to cause the images of objects to fall on the most sensitive parts of the retina, the eyeballs have to excite certain movements, which are preceded by a wish to turn the eyes in the necessary direction. If we wish, *e.g.*, to turn the eyes towards our right side, we have to imagine an object situated in that direction, and then to look towards it. When we wish to converge the eyes, we look towards an object which we imagine situated about the median line of the body.

A continuous innervation of the muscles of both eyes is required to maintain the direction of both visual lines to one point of an object. A person who uses one eye only for vision, may direct the visual line of the other eye properly for certain positions. The eye, the vision of which is impaired, deviates if the object is brought into a position in which an amount of muscular power is required for distinct vision, *e.g.*, when the object is held near the eye.

Each visual line, together with the different parts of the eyeball, moves round an imaginary fixed point, termed the centre of motion, which point lies within the eye.

The angle which the visual line of one eye forms that of the other, when the muscles of both eyes are at rest, is termed the muscular meroropter. The visual lines are then inclined towards each other, and if prolonged, would meet at a point situated at about 6′ from the eyes.

The angle formed by the visual lines when meeting at a point is termed the angle of convergence.

The nearer such point is to the eyes the greater is the angle, *i.e.*, the inclination of the visual lines towards each other. During reading the angle is about eleven degrees (11°).

The axis of the cornea, if prolonged to the opposite point of the eyeball, is termed the axis of the eyeball, or the "visual axis." It does not coincide with the visual line. As stated under *Strabismus*, an eye may apparently squint inwards or outwards, and yet the visual lines may be directed properly. The visual line passes through the cornea near the inner (nasal) side of the axis of the cornea. This axis crosses the visual line at the nodal point (the crossing point of the rays of the eye), under an angle varying in the normal eye from 3° to 7.°

An imaginary plane laid through the visual lines and the point to which they are directed is termed the visual plane.

The movements of both eyeballs may be subdivided into—

(1.) Associated movements. In these the visual lines remain parallel.

(2.) Accommodative movements. In these the visual lines are more or less inclined towards each other.

Some distinguish between a primary position of the eyes in which the visual lines are parallel and 45° below the horizontal, and secondary positions in which the eyes are rotated round a vertical or a horizontal axis, or obliquely upwards or downwards.

Several muscles are at work in every movement to prevent, as some suppose, the individual muscles from becoming fatigued too soon. More muscular power is required when looking upwards or downwards than when looking outwards or inwards. The least fatiguing movement is the one in which both eyes are directed inwards and downwards; the most fatiguing is the one in which they are directed outwards and downwards. When looking at objects, muscular power is consumed in overcoming the resistance offered by the muscles themselves. The action of the contracting muscle is opposed by the elasticity of its antagonist; and further resistance is offered by the structural elements of the contracting muscle itself.

Oblique or diagonal movements require the action of three muscles (of two recti and one oblique).

The vertical meridian of the cornea remains parallel with that of the other during oblique movements upwards, but is inclined towards the side towards which we look. For example, when looking outwards upwards and towards the left, the vertical meridian of the cornea of the left eye is inclined outwards, *i.e.*, towards the left, while that of the cornea of the right eye, remaining parallel with it, is inclined inwards, *i.e.*, also towards the left.

The vertical meridian also remains parallel, but inclined in a direction opposite to the one in which we look during oblique movements downwards. For example, when looking downwards outwards and to the left, the vertical meridians remain parallel, and we are inclined towards the right, *i.e.*, that of the left cornea is inclined inwards towards the meridian line, and that of the right cornea outwards and away from the meridian line.

The oblique movements upwards and inwards is carried out by the superior and internal recti and the inferior oblique. The cornea is drawn upwards and inwards, and rotated inwards. Its vertical meridian is inclined inwards. The superior rectus, contracting somewhat more than the others, is regulated in its action by the superior oblique, which during this movement offers most resistance.

The movement downwards and inwards is carried out by the inferior and internal recti and the superior oblique. The cornea is drawn downwards and inwards, and rotated outwards. Its vertical meridian is inclined outwards. The rectus inferior, which exercises most power, is limited in its action by the superior oblique.

The movement upwards and outwards is carried out by the superior and external recti and the inferior oblique. The cornea is drawn upwards and outwards, and rotated inwards. Its vertical meridian is inclined outwards. The inferior oblique not only counteracts the tendency of the superior rectus to incline the vertical meridian inwards, but even also inclines it outwards.

The movement downwards and outwards is carried out by the inferior and external recti and the superior oblique. The cornea is drawn downwards and outwards, and rotated inwards. Its vertical meridian is inclined inwards.

Vertical Movements.—In these the eyeball is rotated round a horizontal axis, the vertical meridian of the cornea remaining vertical.

The movement vertically upwards is carried out by the superior rectus and the inferior oblique. The eyeball is slightly rotated inwards. The resistance opposed to this movement by the internal and external rectus is greater than when looking downwards.

The movement vertically downwards is carried out by the inferior rectus and the superior oblique. The eyeball is slightly rotated outwards.

During horizontal movements of the eyeball, rotation occurs round a vertical axis. Round this the axis of the cornea, supposing it to stand perpendicularly upon the centre of the vertical axis, can be turned inwards towards the median line, so as to describe an angle of from 42° to 51°, and can be turned outwards, so as to describe an angle of 44° to 49°. The vertical meridian of the cornea remains vertical during the movements.

ACCOMMODATIVE MOVEMENTS.

The most frequent accommodative movement is convergence of both visual lines during reading, "near work," etc. The convergence is least fatiguing, and the reflex action of vision upon the recti muscles strongest, when the visual lines are at the same time directed somewhat downwards.

The power of convergence increases when looking downwards; it decreases when looking upwards.

The power which the internal recti possess to turn both eyes inwards ("to converge the visual lines") varies in eyes otherwise healthy. Some are able to converge with ease to a point situated 1″ or 2″ from both eyes, while others can only converge to a point situated 4″ or 5″ from the eyes.

(See *Insufficiency of the Internal Recti Muscles.*) Great convergence, if too long continued, produces muscular asthenopia.

The power of convergence and divergence, in other words, the strength of the internal and external recti muscles when responding to the act of binocular vision, can be measured with prismatic glasses. (See *Insufficiency.*)

Method of demonstrating the Changes of Position which the Cornea, Retina, etc., undergo during Movements of the Eyeballs.

It has been repeatedly stated above, that the vertical meridian of the cornea of one eye remains parallel with that of the fellow-eye, especially during oblique movements of both eyes. The same is the case with the vertical meridian of the retina.

The movements and positions of the vertical meridian are ascertained in the following manner:—

A piece of red tape is stretched out vertically and level with the eyes upon a bright-gray background, the latter being divided into squares by horizontal and vertical lines crossing each other.

Standing at such a distance from the red tape as to avoid all perceptible convergence of the eyes, we look steadily at the tape for a few seconds. Looking then at some other part of the gray background, we perceive on it a green image of the tape, which after a short time fades away. When we have at once succeeded in producing this image, we find, however much we look horizontally or vertically, the image of the tape remains vertical in relation to the lines drawn on the gray background. Should this not be the case, then the position of the tape must be altered until its image remains vertical during these movements.

The changes of position of the horizontal meridians are ascertained by producing a horizontal image of the tape. On executing other than horizontal or vertical movements, we find that the image of the tape forms an angle with the lines on the background. This angle, which varies according to the degrees of obliquity of the movements, can be measured. We can thus ascertain the extent of change of position of the horizontal or vertical meridian of the retina and cornea during oblique movements.

DEVELOPMENT.

About the end of the third month the muscles can be recognized as fine thread-like filaments. They are well marked about the fifth month, but appear inserted further behind the cornea, so that at that period the anterior two-thirds of the eyeball are in front of their insertion. At the apex of the orbit they are connected with one-another by a reddish substance.

CONGENITAL ANOMALIES.

Absence of one, of several, or of all of the "recti muscles." Presence of all the muscles, the eyeball being missing. Abnormal adhesions of the muscles among themselves, *e.g.*, of the oblique to the recti muscles. Adhesion of the superior oblique to the trochlea. Abnormal length, or shortness, or thickness of the muscle.

NYSTAGMUS.

("TREMBLING OF THE EYEBALL.")

Nystagmus signifies a peculiarly involuntary movement of both eyes, which is the result of quick contraction of antagonistic pairs of muscles, or of entire groups of muscles.

Nyetagmus may be continuous, or appear only during excitement, or when the eyes are brought into certain positions. It may disappear, or nearly so, during reading, and generally increases when the muscles are exerted by looking in rapid succession at different objects. The movements may be jerking, or oscillating in the direction of the recti muscles; or it may be rotatory round the axis of the oblique muscles; or a combination of both. The ordinary movements of the eyes are not interfered with.

Causes.—Nystagmus generally becomes developed during infancy. It has been observed to follow purulent ophthalmia. It is a common combination of atrophy of the choroid (following choroiditis disseminata, with or without opacities in the cornea), or of congenital cataract, or of both.

Vision.—The continuous movement of the eyeballs rarely gives rise to dimness, or uncertainty of vision. Cases have been observed in which distant objects appeared to move, and a few in which this has been the case with near objects also.

Some patients, while reading, counteract the nystagmus by movements of the head; the eye appears more steady. As soon, however, as the head remains quiet, *e.g.*, when looking at distant objects, the nystagmus increases again. In most cases, vision is impaired in consequence of the changes, of which the nystagmus is a complication.

Treatment.—Several cases have been benefited by altering the insertion of the recti muscles by operation.

LUSCITAS.

This term, by some, is applied to an oblique position of one or of both eyes, the mobility being lost entirely, or in part. Luscitas has been observed to accompany changes of shape of the eyeball; and also as a complication of orbital tumors, and of spasmodic and paralytic affections of the muscles.

Rare *anomalies of the action of the muscles* are:—

(1.) Clonic spasm accompanying general (especially cerebral) diseases.

(2.) Tonic spasm, as part of a general spasmodic state in eclampsia, epilepsy, and after injury. The muscles are firmly contracted, the eyeball and the eyelids fixed, and the former drawn backwards into the orbit.

STRABISMUS. ("*Squint.*")

Strabismus is the inability to direct both eyes ("both visual lines") simultaneously to the same point of an object.

One visual line is directed to the object which the patient wishes to see directly, while the other deviates either too much inwards towards the inner canthus, producing strabismus convergens; or outwards towards the outer canthus, causing strabismus divergens. These are the most frequent forms of strabismus.

Apparent strabismus may exist without real strabismus—*i.e.*, the axes of the cornea may diverge or converge too much, and yet the visual lines of both eyes may be directed properly. This apparent strabismus is, as a rule, but slight, and is the result of the too great or too small angle which the visual line makes with the axis of the cornea. This angle in the normal eye amounts to about 5°. We have apparent divergent strabismus, if it is greater than 5°, as it is often the case in hypermetropia; apparent convergent strabismus, if it is less than 5°, as it is frequently observed in myopia.

The degree of strabismus may be measured in the following manner: The patient is directed to look at an object held at 20″ from the eyes. A mark (*a*) is made on the margin of the lower lid of the squinting eye, in a line with the centre of its pupil. The non-squinting eye is then covered ("excluded," but not closed), and the patient is directed to look with the other (squinting) eye at the object. A second mark (*b*) is traced on the same lower lid, in a line with the pupil. The distance of *a* from *b* indicates the degree of the strabismus. If that distance amounts to 2‴, 3‴, or 5‴, we speak of a strabismus of 2‴, 3‴, or 5‴.

MOVEMENTS OF THE SQUINTING EYE AND OF THE FELLOW-EYE.

The deviation of the visual line of the squinting eye, the visual line of the other eye being directed to the point of an object, is termed the primary deviation. The deviation of the visual line of the non-squinting eye, when covered (excluded) while the squinting eye is directed to the object, is termed the secondary deviation.

The secondary deviation, being an associated movement, becomes less if the mobility of the squinting eye diminishes. In this case, the patient often assists the eye by movements of the head.

The properly-directed eye, while looking at an object which approaches it, converges; while the squinting eye, if the object is brought very close, may remain fixed, or squint more, or deviate slowly or suddenly in a direction opposite to "the squint."

The patient may for a considerable time continue to direct the squinting eye properly, when the other eye is excluded. In some cases this power is soon weakened, or even lost. Vision becomes more and more impaired. Abnormal changes of structure (fibrous degeneration) occur in the unduly-contracted muscle and in its antagonist, leading to permanently impaired mobility. It is stated that if this fibrous degeneration has set in, the eye can still be directed to objects, but its movements under such circumstances are uncertain.

The strabismus is termed *concomitant* if the squinting eye accompanies the movements of the other one, except those of extreme inversion and eversion. In concomitant strabismus, the primary deviation is equal to the secondary; while in strabismus following paralysis, the secondary deviation exceeds the primary.

STRABISMUS CONVERGENS.

(*Convergent or Internal Strabismus.*)

Causes.—(1.)—The anomaly of refraction termed Hypermetropia is the most frequent cause. We very rarely err if, when meeting with convergent strabismus, we look upon it as one of the symptoms of hypermetropia.

About 95 out of 100 cases can be traced to this cause.

The origin of strabismus in hypermetropic persons is thus explained: To read or to look at near objects for a prolonged time requires a certain power of accommodation to keep up the necessary curvature of the crystal-line lens, and a proportionate amount of power of the external muscles of the eyeball to maintain the requisite convergence. Accommodation and convergence go hand in hand. Strong accommodation is necessary, accompanied by strong convergence. Hypermetropic eyes, to be able to see distinctly, use more power of accommodation than emmetropic eyes, and simultaneously converge more. While reading type held at a distance of 12″, healthy eyes are directed to a point 12″ distant; but hypermetropic eyes, to read at the same distance, have to accommodate and converge strongly; and though the eyes are directed to a point which lies 12″ distant, there is a great tendency to converge for a nearer point, as may be seen if one eye is excluded, but not closed, while the other looks at the object. The excluded eye, as a rule, at once converges too much. If vision of both eyes is accurate, *then the tendency to use both* (*to maintain binocular vision*) is so strong, that both remain properly directed, and no strabismus arises. Though even then we may find one of the eyes squinting for a few moments, just when commencing to read, and again when "the eyes grow tired."

The occurrence of strabismus is facilitated by diminution of the acuteness of vision of one eye. The second eye, if only one is used, follows the tendency to too great convergence, while the other is directed to the object. Diminished acuteness of vision of one eye may be the result of a high degree of hypermetropia, or of alternations in the refracting media—*e.g.*, opacities of the cornea, etc., etc.

Looking at objects placed laterally, or reading with the book held to one side, so that only one eye is used, allows the other eye to follow the tendency to too great convergence. The convergence of hypermetropic eyes is facilitated by the globular shape of the eyeball admitting of greater mobility, and particularly by the large angle which the visual line makes with the axis of the cornea. The greater this angle, the more readily does the eye follow the tendency to strabismus.

(2.) *Myopia.*—The explanation, how myopia can give rise to convergent strabismus, is given under *Myopia.*

(3.) Inflammation of the internal rectus muscle, occurring together with inflammation of the subconjunctival tissue.

(4.) Paralysis of the external rectus muscle, the convergent strabismus appearing as a latter complication.

(5.) Disease of the brain, *e.g.*, hydrocephalus, tumors in the orbit, displacing the eyeball, or impeding its movements.

GENERAL REMARKS.

The strabismus which is connected with hypermetropia appears as soon as the patient uses his eyes much for near work, *e.g.*, when learning to read. The strabismus at first is periodical, only appearing whenever the impulse to convergence is increased. Periodical convergent strabismus may continue for years, or it may become permanent soon after its appearance. Patients suffering from it, as a rule, are moderately hypermetropic. In such, the acuteness of vision is much improved by excessive efforts at accommodation and convergence. The impulse to convergence is therefore greater than in higher degrees of hypermetropia, in which even great efforts at accommodation do not improve the images on the retina much, and thus do not induce great efforts at convergence.

The strabismus having become permanent, is termed simple, if only one eye habitually deviates, which is usually the case. It is at the same time concomitant, if the squinting eye is properly directed, while the other, when excluded, squints in its turn.

The mobility outwards of both eyes is somewhat diminished, while the power of convergence is increased, and both internal recti are somewhat shortened.

If the strabismus is alternating, *i.e.*, if sometimes one, sometimes the other eye squints, other causes besides hypermetropia must be looked for. Alternations of the contracted muscle may, if existing for many years, lead to loss of contractility through what is termed fibrous degeneration. The internal rectus muscle at the same time undergoes atrophy.

Treatment.—Without an operation. Many cases of periodic, and even of permanent, strabismus occurring in hypermetropics, have been cured by the use of spectacles with convex lens for near work, as well as for walking, and by the application of atropia to the non-squinting eye, so as to thoroughly paralyze its accommodation.

The operation for strabismus should be performed, if the treatment with atropia and spectacles has not succeeded within two or three months.

If, for some reason, the operation has to be postponed, *e.g.*, in a child under the age of five years, we make the patient exercise each eye separately, especially the squinting one, by keeping the other eye closed for several hours every day. The acuteness of vision of the squinting eye is less likely to become deteriorated before the time for operation. Some recommend the use of spectacles with plane glasses: the glass corresponding to the better eye is tinted blue, so that objects appear of a pale-blue tint, and the impressions on the retina become weakened.

Treatment by Operation.—The immediate object of the operation is to alter the insertion of the tendon of the internal rectus muscle, and to retain the full length of the muscle. The tendon should be divided close to the sclerotic. After division, it recedes from its original insertion, and undergoes a new adhesion to the sclerotic. It has been stated that it may be made to recede as much as 3‴.

The muscle, before reaching the sclerotic, passes through the subconjunctival fascia and connective tissue. To these it is attached, as well as to the sclerotic. It recedes too much if it is completely separated from these attachments, as if divided between them. The determination of the degree to which these attachments should be separated (to obtain the desired position of the eyes) constitutes the difficulty of the operation. In severe cases, not only the internal rectus, but also the nearest part of the superior and inferior recti muscles, and the subconjunctival tissue intervening between them, may have to be divided.

The effect of the operation, besides immediately altering the position of the eyes, should be to weaken the contraction of the muscle.

The squinting eye only need be operated upon, if the other, when excluded, does not deviate inwards while the squinting eye is directed to the object.

Both eyes should be operated upon if both squint; or if, the habitually squinting eye being directed to an object, the other eye, when excluded, deviates inwards. In this case we divide the tendon, and more or less of the subconjunctival fascia adjoining it in the habitually squinting eye, while in the fellow-eye we only divide the tendon close to the sclerotic.

No operation should be proposed if the strabismus is connected with the causes given above under 2, 4, and 5, unless these causes have for a considerable time ceased to act.

VISION BEFORE THE OPERATION.

The accuracy of vision of most squinting eyes is defective previously to their squinting. Patients often remark that they see better when they "squint" with one, or, while reading, hold the book towards the side of the non-squinting eye.

A secondary diminution of vision always ensues if the strabismus continues for a long time. On the other hand, the weaker vision becomes, the less power does it exercise over the muscles of the eye.

The field of vision becomes more limited. The functions of the inner half of the retina of the squinting eye persist longer, and assist the vision of the fellow-eye. The rest of the retina becomes more amblyopic. With increase of the deterioration of vision, the eye gradually loses the power of looking steadily at an object.

If this occurs, but little improvement of vision is observed after the operation.

The reason why diplopia is so rarely complained of, seems to be, that the strabismus often commences during childhood, when no attention is paid to the diplopia. Besides, the images of objects formed on the retina of the squinting eye are indistinct, and lie at the same distance from the yellow spot; while the attention is occupied by objects directly looked at.

VISION AFTER THE OPERATION.

One object of the operation is to restore a proper direction of the visual lines for all points of the field of vision, and thus to obtain, as far as possible, binocular and single vision.

Binocular vision is obtained in about half the number of patients operated upon for convergent strabismus. The results are more favorable, the earlier the operation is performed. Much is already gained if binocular vision is obtained even for a limited range of the field. An increase of acuteness of vision from mere recognition of large letters before the operation, to ability to read ordinary type immediately after it, is often observed. This is perhaps connected with a change which occurs in the ciliary muscle after division of the tendon of the internal rectus muscle.

Diploplia often appears immediately after the operation, but, as a rule, disappears spontaneously. It is more troublesome if the double image is slanting, or stands above, or behind the true one. If, after from six to eight weeks, it still persists, prisms may be tried. (See *Diplopia.*) Among a very large number of cases operated upon, in which the position and movements of the eyes, and the acuteness of vision, and accommodation appeared normal, few cases have occurred in which a slight diplopia could in no way be removed by prisms.

MOBILITY OF THE EYE AFTER THE OPERATION.

The separation of the muscle from its original insertion causes it to recede to an extent at from 1‴ to 3‴, and thus a diminution of the mobility of the eye towards the side operated upon is effected. This mobility having been too great towards the squinting side, a slight receding of the insertion is still compatible with normal, or nearly normal, mobility.

All movements are restored to the normal state in a small number of cases only. The result may be considered as satisfactory if both eyes are properly directed to an object placed at a distance of ten feet, and if they continue so while approaching the object to within 4 inches from the eyes; also if, on excluding one eye, there is no deviation of the excluded eye. Parallelism of the visual lines for extreme convergence and divergence is rarely restored. If, in from six to eight days after the operation, all other points of treatment having been observed, the eyes can only be brought to converge to a point situated 8 inches from the eyes, and not nearer, divergent strabismus must be counteracted by subconjunctival division of both external recti.

Operation.—Before I give the opinion of others, I shall state in as few words as possible the operation given by myself.

I shall describe the operation as performed upon the rectus internus, for convergent strabismus; all the other operations, when required, being executed in a similar manner.

The surgeon should be provided with a spring speculum, toothed forceps, a pair of blunt-pointed forceps, a round strabismus hook, a small, soft piece of sponge, and a bowl of water.

The sitting position is the best for the patient, during the operation of strabismus, for it allows the blood to escape readily from the little wound, instead of lodging in it, and obscure the parts to be divided. With unsteady patients, it is a useful precaution to secure the arms by means of a broad belt and buckle passed round the back of a chair. Patients or adults very seldom require chloroform in this little operation, as there is very little pain attending it; the speculum gives more pain than the operation.

The first thing I do is to place the patient in a chair; I sit myself in another. I let his knees come between mine, and get as close to him as I can. I place the strabismus box of instruments on his knee; the assistant stands behind the patient, receives his head and holds it steadily, after which I separate the lids with a spring speculum. I take the toothed forceps in my left hand, between my first finger and thumb. I place my little finger on the frontal bone or forehead, to steady my hand. I tell the patient to turn his eyes outwards.

I then seize a small fold of the conjunctiva and subconjunctival fascia; this is to be raised with the forceps half way between the cornea and the inner canthus, and divided with the scissors in an oblique direction, and a little below the equator of the eyeball, that the incision may be over the edge of the muscle. The blunt hook is then taken in his right hand, and then passed under the muscle, drawn out towards the external wound; then it is passed over to his left hand, and then he (as is shown in Fig. 27) takes in his right hand the probe-pointed scissors and divides the muscle.

Should the breadth of the muscle or the smallness of the opening prevent the point of the blunt hook from being brought out at the wound, the conjunctiva may be seized with the forceps and slid back over the point, so as to allow of the division of the muscle without enlarging the conjunctival wound; or this may be divided to a further extent at the same time with the muscle. Should the eyes not appear parallel on testing them, the blunt hook should be again passed in, to explore if any fibres remain uncut.

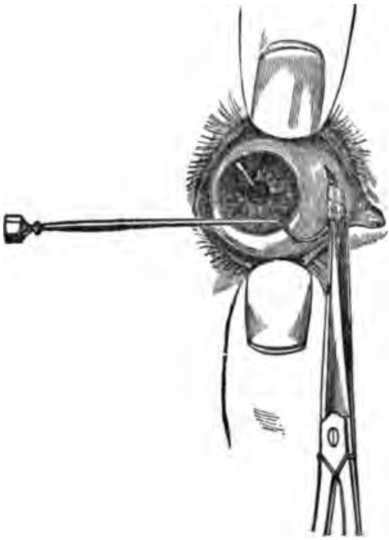


Fig. 27.

When the deviation is slight, an operation on one eye is generally sufficient; but where convergence is very marked in both eyes, it is frequently necessary to perform a double operation before perfectly harmonious action is recovered. Both eyes are to be operated on, by all means, at the same sitting. No after-treatment is generally required, in either form of operation, except a little cold water with which to bathe the eyes two or three times a day.

Should a fungus make its appearance in the wound, when the conjunctiva has been divided, it may be snipped off with scissors at a single stroke, or will fall off after some time, if left to itself.

Time for Operating.—Any and all seasons may be selected for the operation, which is of so slight importance, as regards any after effects to be dreaded, that very few precautions are necessary. After the operation, I highly recommend goggles, with small apertures, for a week or two, particularly when only one eye is operated upon.

CHARLES BARDAO'S OPERATION.

Children and restless patients should be operated upon under chloroform.

The patient lies on the back, the head being slightly raised and well steadied. The eyelids are kept open with the wire speculum. The eyeball is fixed by means of forceps. This is done by placing a pair of closed forceps perpendicularly upon it, near the inner margin of the cornea; then, while pressing gently upon the eye, the forceps are made to glide down to the spot where we propose to make the incision. There the forceps are allowed to open, and some of the conjunctiva and subconjunctival tissue is seized. Close to this, *i.e.*, at the lower edge of the incision of the internal rectus muscle, a small opening, about ⅛ inch in length, is made into the conjunctiva and subconjunctival fascia with the blunt-pointed strabismus scissors, so as clearly to expose the sclerotic.

The strabismus hook is now passed through the incision along the sclerotic, and placed between the eyeball and the incision of the muscle. If introduced properly, when we try to draw it forwards towards the cornea it becomes arrested at the point where the tendon is inserted into the sclerotic; while, if it has merely been introduced beneath the conjunctiva, it can be drawn up to the margin of the cornea, beneath that membrane. The hook being placed between the tendon and the eyeball, the scissors are introduced through the incision, and the subconjunctival tissue is divided in front of the insertion of the muscle. The tendon is next divided close to the sclerotic, one blade of the scissors passing along the hook, and the other in front of the tendon. The gliding forwards of the hook beneath the conjunctiva up to the margin of the cornea is a sign that the tendon, or the part impeding the advance of the hook, has been divided. The hook should be repeatedly introduced, to ascertain whether the insertion of the tendon has been completely divided. Whether, and to what extent, the subconjunctival fascia adjoining the muscle may have to be divided, is a matter of experience, determined by the degree of strabismus. The eye which squints most is operated upon first.

Much blood occasionally is effused beneath the conjunctiva. An opening should be made at the most bulging part, to allow it to escape. From four to six weeks may elapse before it has all disappeared.

Cold applications to the closed lids a few hours after the operation will be found grateful. No further treatment is required. The patient may go about the following day, and use the eyes, except for near work, reading, etc., which, however, may be allowed a week after the operation.

Among the accidents which may occur during the operation must be mentioned the wounding of the sclerotic, one of the blades of the scissors being thrust into the vitreous chamber. This grave accident is guarded against by the blades being blunt-pointed, and manipulated in such a manner as to cut along the surface of the sclerotic.

If, after all undue vascularity and suffusion have subsided, the strabismus reappears, in spite of the operation having been performed properly, spectacles to remove the hypermetropia should be worn for reading and other near work.

A second operation may have to be performed if the strabismus returns, and the impossibility of removing it by other means has been established. Sometimes it suffices, at the second operation, to divide the internal rectus muscle of the eye the vision of which is the most acute. The range of movements being less, too great inversion of the fellow-eye is prevented.

Should slight divergent strabismus follow, and the division of the external rectus be determined upon, the operation should be performed subconjunctivally on both eyes, and as soon as the divergence becomes evident; but not until all effused blood from the primary operation has disappeared.

Before operating a second time, we ascertain whether, with spectacles which neutralize the hypermetropia for all distances, reading with both eyes is possible, the book being held at 6″ or 8″ from the eyes: if so, no operation is necessary, and the divergence must be attributed to the large angle which the visual line makes with the axis of the cornea.

Many, especially Continental surgeons, divide the conjunctiva *over* the insertion of the muscle, instead of at its lower margin. They pass a small strabismus hook between the tendon and the eyeball, bring the insertion of the tendon into view, and then divide it close to the sclerotic. The wound in the conjunctiva is closed by a suture which runs from the angle of the wound next the caruncle to the one next the cornea. Thus the caruncle, which by this mode of operating is apt to sink back more than by the subconjunctival method, can be raised. Again, by enclosing more or less conjunctiva within the suture, the muscle can be drawn forwards while tying the suture, and, as is asserted, the point of its new insertion can be regulated. Those who adopt the mode of operating have laid down rules as to the cases in which it is necessary only to divide the muscle, and those in which the suture must be inserted.

About two-thirds of a line of conjunctiva enclosed by the suture on either side of the incision suffice to raise the caruncle without altering the position of the divided tendon. The tendon may be carried back to its original insertion, if much conjunctiva is enclosed in the suture.

The position and mobility of the eyes are tested immediately or a few hours after the operation; and the suture is loosened, or tigntened, as may be required to regulate any faulty position, etc. In strabismus of 1½‴ to 2‴, no suture need be applied. In children, the divided muscle recedes more, and a strabismus of 2‴ to 3‴ requires no suture. In grown persons with strabismus of 2‴ to 2½‴, the insertion of the tendon must be exposed freely, some of the adjoining subconjunctival tissue be divided, and a suture applied. In strabismus of 5‴, both eyes have to be operated upon: in the squinting eye, a strabismus of 2½‴, and in the fellow-eye one of 1½‴ is corrected. A suture is inserted in each eye.

STRABISMUS DIVERGENS.

("*External or Divergent Strabismus.*")

Causes.—(1.) *Anomalies of the functions of the muscles*, whether congenital, or following disease or operations (*e.g.*, for convergent strabismus). Such anomalies are spasm, insufficiency, and paralysis.

The insufficiency may be the result of faulty shape of the eyeball; or of congenital weakness of the internal, or of undue power of the external recti muscles; or of the operation for convergent strabismus, causing too great receding of the internal rectus.

(2.) *Myopia.*—In every case of divergent strabismus, we should ascertain whether myopia is present. It is the most frequent cause of divergent strabismus. The latter at first is but slight, and may remain stationary. If it increases, it does so slowly.

The increase of the myopia, *i.e.*, the enlargement of the eyeball, gives rise to difficulty of convergence. The images of objects which are placed at equal distances from both eyes are less perfect on the retina of the more myopic eye. Vision of one eye being less perfect, the impulse given by binocular vision to maintain the convergence of the eyes is weakened, and the divergence of the weaker eye facilitated.

The eyeball which resists the converging power most, soonest induces fatigue of that power; and the eye diverges the quicker the more convergence is required, as in reading, or other near work. The attempts of the "converging" muscles to maintain binocular vision lead to fatigue, and the eye rests itself by diverging.

The divergence is facilitated by the smaller angle which the visual line forms with the axis of the cornea.

(3.) *Impairment of Vision.*—An eye the vision of which is impaired to such an extent that it no longer assists the fellow-eye in near work, reading, etc., may become divergent whatever be the state of its refraction. The anomaly of refraction may be the cause of the impairment of sight, and thus indirectly the cause also of the divergence.

It has been observed that all other parts being normal, no divergence has occurred through the retina of one eye being amaurotic in the region of the yellow spot, if the peripheral parts of the retina have remained sensitive.

Amaurosis, whatever be its cause, if confined to one eye, is generally followed by divergent strabismus. This not unfrequently occurs in both eyes, if both are amaurotic. The internal recti are no longer excited to contraction, and their power gradually decreases.

Divergent strabismus, including slight cases, is as frequent as convergent strabismus. In 90 per cent. of cases it is a complication of myopia. It is generally confined to one eye. The most extreme forms occur after long-continued paralysis of the internal rectus muscle, and after operation for convergent strabismus.

GRADATIONS OF DIVERGENT STRABISMUS.

(1.) *Alternating Relative Divergent Strabismus.*—After maintaining both eyes properly directed for some time, one eye diverges through its internal rectus becoming fatigued. After rest, the convergence can again be maintained.

(2.) *Relative Divergent Strabismus.*—The power of convergence, when looking at near objects, remains insufficient, while it continues undisturbed when looking at more distant objects. The relation between convergence and binocular vision is only disturbed for certain distances. When looking at distant objects, this may be combined with convergent strabismus as the result of impaired functions of the external recti muscles. In high degrees of myopia, in which objects must be held very near to be seen distinctly, the convergence of the eyes is often imperfect, and relative divergent strabismus is the rule.

(3.) *Absolute Divergent Strabismus.*—At *no distance* can both eyes be brought to converge to the same point. The divergence exists for all distances, though it may diminish when one eye looks at near objects. Neither binocular vision, nor attempts towards it, longer exist.

The diverging eye may be blind, or at least not participate in binocular vision. Comparatively few myopic eyes with relative diverging strabismus become absolutely diverging. Paralysis of the internal rectus muscle—unsuccessful operation for internal strabismus—and especially amaurosis—furnish a large number of cases of absolute divergent strabismus.

Treatment.—If the diverging eye is blind, or can only perceive large objects, no benefit is derived from treatment by optical means. It may, to improve the patient's appearance, become desirable to make the diverging eye assume a position similar to that of the normal fellow-eye when looking at objects from 5 to 15 feet distant. This position, in slight cases, is obtained by dividing the conjunctiva, subconjunctival tissue, and the tendon of the external rectus muscle of the diverging eye. If this does not produce the desired effect, we divide the conjunctiva and subconjunctival tissue as far as the nearest margin of the superior and inferior recti muscles, and likewise, but subconjunctivally, the tendons of these two muscles. Should this not succeed in restoring the required position, then the tendon of the internal rectus has to be divided also, and the end of the tendon, which remains attached to the muscle, has to be stitched to the conjunctiva and subconjunctival tissue near the cornea. To secure the new attachment of the tendon, a large portion of the conjunctiva and of the subconjunctival tissue must be enclosed in the suture; and care must be taken, while tying the suture, that it does not give.

The eyes, after these operations, must be kept closed until all "redness" has disappeared. Lint dipped into cold water is applied frequently to the closed eyelids of both eyes for two days after the operation.

It is better not to administer chloroform while our operations remain confined to the external, superior, and inferior muscles. If the position obtained is not satisfactory, then chloroform is given, and we proceed to the division, etc., of the internal rectus muscle.

If with the diverging eye the patient can recognize large letters, or even read small type, the operations described above can also be recommended, provided the eyes are not myopic.

If the diverging eye is myopic, some advantage as regards position when looking at distant objects is derived from the division of the tendon of the external rectus muscle.

Some advise, if one myopic eye is used for reading, and the diverging fellow-eye for distant objects, not to operate, but to allow the patient to continue using the eyes in this manner.

SUBCONJUNCTIVAL OPERATION FOR STRABISMUS.

For the subconjunctival operation, the instruments necessary are a small hook or forceps to raise a fold of the conjunctiva, a lance-shaped knife curved on its flat surface, and a probe-pointed knife like those used for tenotomy, but having a peculiar bend of its shaft near the handle.

It is well to cover the other eye, that the affected eye may move more freely, and may be directed forwards at the moment of commencing the operation. A fold of the conjunctiva over the lower edge of the internal rectus is raised with the forceps, and the lance-shaped knife is passed through this membrane and the fascia beneath it, and carried into the sheath of the muscle, so as to pass behind it. Its convex surface is to be directed towards the globe, that the risk of puncturing the sclerotic may be avoided. The probe-pointed knife is then to be passed through the wound and behind the muscle, which is to be divided by turning the edge of the knife forward, and giving it a slight sawing motion, the patient being directed to turn the eye outwards as much as possible; or, if necessary, the globe being turned in this direction by seizing it with the forceps, so as to render the fibres tense and facilitate their section. The advantages of this method are, that the danger of falling back of the caruncle to hide itself at the inner canthus, or of the formation of granulations in the wound of the conjunctiva, are avoided. Its disadvantages are, the considerable ecchymosis which results from the effusion of blood between the conjunctiva and sclerotic, the greater difficulty of determining whether all fibres of the muscle have been completely severed, and the danger of penetrating the globe with the instrument used for making the puncture; a danger which has not always been avoided, even by skilful operators.

PARALYSIS AND PARESIS.

Causes.—Paralysis and paresis may be the result of morbid changes:—(1.) Implicating the nerves of the muscles; (2.) Occurring in the muscles themselves; or (3.) Affecting both simultaneously.

The causes may be classed according to the seat of the lesion which gives rise to the paralysis.

Intercranial and Cerebral Causes.—In these, the paralysis is often complicated with impairment of memory or of speech, with paralysis of other nerves, with anæsthesia, etc.

Paralysis progresses rapidly in plastic effusions at the base of the brain. Several muscles in both eyes, or several in succession, become paralyzed.

Ptosis is frequently, lagophthalmos only exceptionally, present.

Paralysis of the third, fourth, fifth, and sixth nerves, with hemorrhage into the retina, has been observed, in the course of aneurism, if the arteria cerebrar is posterior.

The third nerve, where it emerges from the brain, is surrounded by numerous arteries. Its paralysis is rarely complicated with hemiplegia.

Orbital Cases.—Periostitis—abscess—tumors (neuroma, exostosis, etc.)—effusion of blood.

(The passage of the nerves through narrow fissures, the numerous bloodvessels near the nerves, and the attachment of the muscles near each other, favor the occurrence of paralysis, if morbid changes become developed in the orbit, or at its inlets.) —Inflammation of the subconjunctival fascia (of Tenon's capsule), (accompanied by pain round the orbit, and when moving the eye).

Injuries.—The operation for strabismus, followed by divergence of the eye in the direction of the antagonist. (Both muscles may undergo secondary changes, the divided muscle becoming atrophic, and its antagonist "fibrous.")

Destruction of the muscle by suppuration.

Distension of the muscles by protrusion of the eye.

Atrophy of the muscles (congenital, or through some of the above changes).

Syphilis, in one-half of the cases, is found to be the primary cause.

Mobility of the Affected Eye.—We distinguish between impaired (paresis) or completely arrested mobility (paralysis) of the eyeball in one, in several, or in all directions. Those acquainted with the functions of the muscles in health will have little difficulty in determining which muscle or muscles are affected, when the patient is unable to make the eye assume any desired position.

Paresis of one, or of several muscles, readily becomes apparent during accommodation for near objects, during reading, etc., in which case all muscles are required to act. A morbid deviation soon arises in the direction of the antagonist of the paretic muscle.

Symptoms of fatigue appear in paresis in the impaired muscle first, if, while the patient holds the head steady, and only moves the eyes, we make him look at an object held in succession in different parts of the field of vision. The fatigue becomes the more evident the longer such experiments are continued; in other words, the more the affected muscle is taxed. The eye, in well-marked cases, can only follow the object up to a certain point, when the movements become jerking or uncertain. The eye finally deviates in the opposite direction.

When we "exclude" the normal eye, and watch its movements behind the hand, we find that, while the paretic eye looks steadily at an object, the simultaneous movement ("the deviation") of the excluded normal eye is greater than that of the paretic eye. The same effort of the will acting upon the muscles of both eyes, the one with the weaker ("paretic") muscle responds to it by a lesser movement. The paretic muscle, to direct the eye to an object, requires a stronger impulse of the will (a strong innervation). The same impulse, acting upon the healthy muscles of the fellow-eye, gives rise to too great deviation of the healthy eye. The deviation of the impaired eye is termed primary, that of the normal eye secondary. In the degree of the two deviations we possess a means of measuring the paresis. For example, if the left external rectus muscle is paretic, we exclude the right eye, and cause the left to look at an object held towards the left side. We then find that, to make the left external rectus muscle carry out the necessary contraction, an innervation (an effort of the will) is required which is much stronger than the one which would be required for the same contraction in health. The effect is, that the same impulse being given to the muscles of the normal fellow-eye to carry out the necessary associated movement inwards, this movement becomes too great, and the eyes squint inwards. Another illustration of difference of contraction of two muscles under the same effort of the will, is afforded by paresis of the superior rectus, while the levator palpebræ of the same eye remains intact. When looking upwards, the upper lid of the affected eye appears raised more than that of the fellow-eye, in consequence of the paretic upper rectus muscle not being able to respond to the impulse of the will to the same extent as the "levator palpebræ."

Strabismus may develop itself as the result of changes in the paralyzed muscle, and contraction of its antagonist. Paresis or paralysis of one eye may induce strabismus of the fellow-eye, if the vision of the affected eye be the more perfect. The efforts to direct the visual line of the affected eye to the object give rise to too great associated contraction of the muscles of the fellow-eye, and finally to strabismus. Paralysis may lead to strabismus through the non-paralyzed muscle altering the position of the eye so as to remove troublesome diplopia, *i.e.*, to cause the double image to fall on a more eccentric part of the retina.

All trace of paralysis having disappeared, concomitant strabismus may remain. In this case, the usual operation for strabismus is performed.

Vision.—The anomalies of vision usually observed are:—Diplopia, impaired judgment as regards the position of objects, and amblyopia, if the paralyzed eye has not been used for a considerable time.

In fresh cases of paralysis, as long as no attempt is made to call into action the paralyzed muscle, no *diplopia* is observed. In some cases of long standing, with morbid convergence or divergence, secondary contraction of the antagonist of the paralyzed muscle often occurs, which may give rise to the diplopia extending over a large portion of the field of vision. This secondary contraction appears to occur sooner, if, previous to paralysis, vision has been impaired, or if there is great difference of refraction of the eye.

Some patients avoid the diplopia by keeping the lids of the affected eye closed; or they assist the paralyzed muscle by moving the head, *e g.*, by turning it towards the right side, if the right eye cannot look in that direction. Holding the head in peculiar positions assists the affected eye in avoiding those movements which would require a contraction of the impaired muscle.

The symptom diplopia is sufficient to enable us to determine which muscle is paralyzed, and to what degree:

In order to find, in slight cases, which eye is affected, we direct the patient, while he looks at an object, to close the eyes alternately when the image of the object belonging to the affected eye is described as moving. In slight diplopia, the images partly cover each other, or the objects appear surrounded with a halo. To facilitate the distinction of the images, we make the patient look through a slip of red glass placed before the normal eye. This causes one image to appear colored red, and less brilliant. The double image is the less striking the further it lies from the yellow spot.

The double image is seen at a spot opposite to the one which it occupies in the retina: *e.g.*, if the eye deviates upwards, the image is formed on the upper part of the retina above the yellow spot, and is seen by the patient below the image seen by the normal eye.

Diplopia from paralysis of the oblique muscle persists for a long time, and can, by the aid of the tinted glass, easily be made perceptible to the patient.

The judgment as regards the position of objects is impaired. The patient, on closing the normal eye, and using the affected eye only, misses an object when attempting to touch it quickly, if the object be held in the part of the field of vision which would require the help of the paretic or paralyzed muscle to direct the visual line. The power of localizing objects in the field of vision depends chiefly upon the sensation of contraction of the muscles of the eye. The insufficiently innervated muscle requires a much stronger impulse of the will to effect a certain movement than would be required in health to effect the same amount of movement; and the patient, misled by the strength of the impulse, overestimates the contraction effected by the impaired muscle, believes the object to be more towards the side of the impaired muscle, and aims too much towards the side.

This symptom disappears after the impairment has existed for some time. The judgment as regards the position of the field of vision, and of the objects in it, becomes altered gradually.

The difference between the imaginary and the real position of an object gives rise to the sensation of dizziness; and the patient, with the normal eye closed, when quickly walking towards a fixed object, turns towards the side of the paralyzed muscle. The dizziness is greater if the diplopia is but slight.

GENERAL REMARKS, ESPECIALLY ON PARALYSIS OF THE THIRD NERVE.

Paralysis of all the muscles of the eye is generally a complication of cerebral or spinal disease. The paralyzed eyeball is slightly protruding, and immovable. The visual line is directed straight, or slightly outwards and downwards. The iris and the ciliary muscle are paralyzed. The upper lid is drooping.

The muscles most frequently paralyzed are those supplied by the third and sixth nerves.

Paralysis of the third nerve frequently extends over all its branches. The paralysis may affect only part of a muscle, or one or several muscles in each eye. If complete, it is combined with ptosis, which is still more considerable if the orbicularis muscle is also paralyzed. The eye diverges slightly. It cannot be directed inwards (paralysis of the internal rectus); it cannot be directed upwards (paralysis of the superior rectus and of the inferior oblique, which latter is less frequently implicated). When attempting to look down, the superior oblique alone acts, rotating the eye slightly inwards, the inferior rectus being paralyzed. The pupil, as a rule, is dilated, and further dilatable by atropia. The ciliary muscle is generally impaired, and often paralyzed.

Secondary contraction of the external rectus soon follows, causing "divergent strabismus." Vision with both eyes is at first much disturbed. The affected eye diverges when steadily looking at an object placed in the median line, the normal eye being closed. Great dizziness is complained of.

In paralysis of the third nerve, the double images, when looking straight forward, are crossed; the false image stands somewhat lower, with its upper end inclined towards the normal eye. The inclination increases when looking upwards, and becomes greatest on looking upwards and outwards. The difference in the lateral distances of the images increases with increasing deviation of the object towards the side of the normal eye. The difference in height increases when raising an object above the horizontal line; and decreases on lowering the object below that line, or when looking outwards and downwards. The action of the superior oblique may cause this difference to disappear. Objects, during attempts at accommodation, appear smaller, and nearer the affected eye.

Prognosis and Treatment.—The prognosis of paralysis or of paresis is more favorable, if syphilis or rheumatism is the cause, —if the cause lies within the orbit,—if the paralysis is fresh,— or if there is only paresis;—or if the double images stand side by side, without any difference in their height. The prognosis is bad if long duration has led to atrophy of the nerves or muscles, with or without contraction of the antagonist.

The *general medical treatment* depends upon the cause.

Locally, we have to attend to the conveniences which arise— from the diplopia,—from the impairment of vision,—and from the impairment of mobility and its consequences, *e.g.*, secondary strabismus, insufficiency, etc.

The diplopia is generally troublesome if vision of both eyes is acute, and the double images stand close to each other.

If there is paralysis, the inconvenience arising from diplopia is avoided by keeping the affected eye closed, or by wearing spectacles with a tinted glass for the paralytic eye.

In paralysis of the superior oblique (the inclined retinal images being above, and internal to the yellow spot), the diplopia may be removed by placing in front of the eye a prism with the refracting angle upwards and slightly inwards. If the inclination of the retinal image is too great, it may suffice to remove by prisms the lateral distances of the double images.

If there is a difference in the lateral distances and in the heights of the images, the image of the affected eye standing lower, we remove the difference in height by placing a prism with the refracting angle upwards before the affected eye. A second prism with the refracting angle inwards is placed before the normal eye, if the difference of the lateral distances is not removed by spontaneous contraction. This prism induces a convergence of that eye and an associated movement outwards of the fellow-eye, thus uniting the still laterally displaced images.

The treatment of diplopia from paresis is adopted, if the deviation, and with it the distance of the double images from each other, is so great that no discomfort is felt, or if the affected eye-muscle has regained some contractility.

If there is paresis, the affected eye should be used frequently alone, so as to practise the paretic muscle, while the normal eye is kept closed. Prisms may be tried to bring the double images near each other, and thus to excite contraction of the paretic muscle to unite the images. The prism suits if it enables the eyes to see single without there being a sensation of straining. The prism at first should be used for objects situated not nearer than 10 feet from the eyes. Less contraction of the muscles is required at that distance, and also at greater distances. The prism, if too weak or too strong, may cause contraction of the antagonist of the paretic muscle. If the prism is too weak, the distance of the double image from the yellow spot remains too great to be overcome by contraction of the paretic muscle; and, instead of contraction of the paretic muscle, contraction of its antagonist ensues to remove the diplopia.

If no tendency exists to unite the images, or if this tendency is very slight, or if stronger prisms than of 14° are required to bring the images near each other, then prisms must be given which completely unite the images; the refracting angle being directed inwards in paresis of the external rectus, and outwards in paresis of the internal rectus.

If these remedies do not remove the diplopia, the paresis or paralysis having existed for two months or more, without any contraction of the antagonist having followed, then an operation may be recommended, the result of which is better if the contractility of the affected muscle is good. Tenotomy of the antagonist of the affected muscle should be performed, and have the effect of producing single vision for near work.

If this result is not produced, and diplopia continues during reading, then, in addition to the first operation, tenotomy of the paretic muscle should be performed, and its tendon should be attached nearer the cornea.

The object of these operations is to assist the contraction of the affected muscle, by advancing its insertion, to weaken its antagonist by carrying its insertion further backwards, and to remove the diplopia as much as possible, especially for reading, etc.

Cases have occurred in which the double images, though close to each other, could not be made to unite. This was attributed in some to cerebral changes, in others to an anomaly of accommodation.

In paralysis which has existed for a considerable time (for two months and longer), satisfactory results have been obtained from the use of electricity.

PARALYSIS OF THE INTERNAL RECTUS MUSCLE (BRANCH OF THE THIRD NERVE).

Symptoms.—Movements.—The inward movement of the affected eye is impossible, as far as the internal rectus is concerned. A slight inward and downward movement is effected by the combined action of the superior and inferior recti muscles. The eye diverges sooner when looking upwards than when looking downwards.

In paresis, the associated movement of the external rectus of the normal eye, when excluded, is too great. The patient, to avoid the diplopia, turns the head towards the side of the normal eye.

Vision.—Diplopia appears when looking towards the side of the paralyzed muscle. The line, dividing the field of vision in which diplopia is observed, is not vertical, but oblique, running from without and above, inwards and downwards. The double images are crossed, level, and parallel with each other. Their lateral distances increase the more the object looked at is placed towards the side of the unaffected eye. The double image, instead of remaining parallel with that of the fellow-eye when looking obliquely upwards or downwards, remains vertical, while the image of the unaffected eye is inclined outwards. The height of the images differs through the vertical meridian of the affected eye, being inclined outwards, although the height of the cornea appears unaltered. The image is formed on a part of the retina external to and above the yellow spot, and therefore is seen internal to and below that of the fellow-eye. A prism held before the affected eye with the refracting angle directed outwards unites the images.

PARALYSIS OF THE INFERIOR RECTUS MUSCLE (BRANCH OF THE THIRD NERVE).

Symptoms.—Movements.—The eye cannot be directed downwards, and when attempting to do so, it turns outwards and upwards. Even when looking at objects placed horizontally, the eye already deviates slightly outwards. The paralysis makes itself most felt when attempting to look downwards and outwards.

In paresis, when excluding the normal eye and directing the paretic eye downwards and inwards, a greater associated movement of the excluded eye downwards and outwards is observed.

Vision.—Diplopia appears when looking downwards. The double images are crossed. The one of the affected eye stands deeper, lies on the side of the normal eye, and is inclined towards the median line (towards the image of the normal eye); thus the upper extremities of both images stand nearer each other. The obliquity of the images and their height increases the more the image is moved inwards and downwards. The image is formed on the retina above the yellow spot, and is therefore seen below that of the normal eye. The refracting angle of a prism, to unite the double images, has to be held upwards, and slightly outwards. The patient, when attempting to touch an object, passes beneath it.

PARALYSIS OF THE SUPERIOR RECTUS MUSCLE (BRANCH OF THE THIRD NERVE).

Symptoms.—Movements.—The affected eye, when trying to look upwards, deviates slightly outwards and downwards, through the action of the inferior oblique being no longer opposed by that of the superior rectus.

In paresis, when raising the visual line above a certain height, an unnatural rising of the lid is observed—*i.e.*, more of the sclerotic is exposed on the normal than on the paretic side. The associated movements of the excluded healthy eye upwards and outwards are too great when the paretic superior rectus muscle acts.

Vision.—The patient, when striking at an object, aims too high.

Diplopia appears on looking upwards. The images of objects fall on a part of the retina which lies outwards and downwards from the yellow spot. The double images are crossed, and do not stand parallel. The inferior oblique being unopposed, the vertical meridian is inclined outwards, and the crossed double images diverge above. This obliquity increases during divergence. The height of the image increases when the eye diverges, and decreases during convergence.

PARALYSIS OF THE INFERIOR OBLIQUE MUSCLE (BRANCH OF THE THIRD NERVE).

Paralysis very seldom affects this muscle alone. The affected eye, when attempting to look upwards, deviates downwards and inwards.

Vision.—Diplopia only appears when the object is raised above the horizontal median line; it is homonymous, the double image at the same time standing higher, and being inclined inwards. The position of the double image is most striking when the object looked at is moved in a direction opposite to that of the affected eye; while its inclination increases when the object is moved outwards, towards the side of the affected eye.

PARALYSIS OF THE SUPERIOR OBLIQUE MUSCLE (FOURTH NERVE).

Symptoms.—*Movements.*—The affected eye, when looking at an object placed in the horizontal median line, deviates slightly inwards and upwards. The deviation increases when the object is moved outwards. The eye deviates outwards if the object is held above the horizontal median line. The affected eye moves downwards and outwards when the fellow-eye is excluded, while the latter makes a stronger associated movement downwards and inwards. Secondary contraction of the inferior oblique ensues if the paralysis persist for a long time; and the cornea of the affected eye comes to stand higher during all movements.

Vision.—At first objects seem to move, and one eye has to be kept closed when reading. This is soon followed by well-marked diplopia, which especially appears when looking downwards. In fresh cases the diplopia is confined to the half of the field of vision which is situated below the horizontal plane, while in cases of long standing it extends over the entire field. The double image is homonymous (lies on the side of the affected eye), if the object, the image of which is formed on the retina inwards from and above the yellow spot, is held below the horizontal median line. If the object is held above that line, the double image is crossed (divergent strabismus), stands deeper, and is inclined outwards.

Diplopia, with strabismus, when looking downwards, is the chief symptom of this form of paralysis.

The difference in height, inclination, and distance of the images increase when the object is moved downwards in the median line. Moving it in the lower half of the field of vision towards the side of the normal eye causes a decrease of the lateral distances and of the inclination, and an increase in the height. The double image appears above the normal one if the object is held far down in the lower half of the field, though the cornea of the affected eye stands higher. Moving the object in the lower half of the field of vision towards the affected eye causes a rapid decrease in the height of the images and in their lateral distances, while their inclination increases. Through excessive increase of the vertical meridian, one image appears to lie nearly above the other. The patient, when attempting to touch an object quickly, misses it, and strikes too low, and towards the side of the affected eye.

The double image appears to lie nearer than that of the other eye. Some describe it as appearing bent, or its upper part further distant than the lower one. In fresh cases, the head is held forwards to cause the double image to be seen in the upper half of the field of vision.

PARALYSIS OF THE EXTERNAL RECTUS MUSCLE (THE SIXTH NERVE).

Symptoms.—Movements.—The affected eye cannot be directed horizontally outwards. The attempt to do so gives rise to an irregular jerking movement, caused by the alternating action of the superior and inferior oblique, the former drawing the eye downwards and outwards, the latter upwards and outwards. An abnormal convergence appears when looking upwards, though less than when looking downwards or straight forwards. The convergence is the greater the more an object is held towards the side of the paralyzed muscle.

Vision.—Diplopia appears when, without moving the head, the patient looks at an object placed in that half of the field of vision which lies next the paralyzed muscle.

The double images are not crossed, but stand parallel to each other, and side by side. Their distance from each other is the greater, the more the object is moved in a horizontal direction towards the side of the paralyzed muscle. When looking outwards and upwards, the double image stands higher, and is inclined inwards. It stands deeper, and is inclined outwards when looking outwards and downwards. The patient, to avoid the troublesome diplopia, turns his head towards the opposite side, and holds objects towards the side of the paralyzed muscle. When quickly striking at an object held into the half of the field of vision next the paralyzed muscle, he misses it, by striking too much towards the side of the affected muscle.

CATARACT.

GENERAL REMARKS.

In the following remarks, concerning some of the more important operations practised on the eye, I have endeavored to confine myself to such a general description as may render the principles upon which they are founded intelligible to the student, rather than to give him minute directions for every manipulation which their accurate performance demands.

There are so many points of detail to be borne in mind during the extraction of a cataract, or the formation of an artificial pupil, that almost every case becomes a study in itself. The most labored written instructions will never suffice to form a skilful practitioner, nor confer that presence of mind, and readiness to take advantage of circumstances as they arise, which, although required in every branch of Operative Surgery, are yet preëminently necessary in that connected with the eye.

There are three principal methods of removing an opaque lens from the axis of vision:—

1. By thrusting it in such a manner from its natural position that, although left in the eye, it may not prevent the rays of light passing uninterruptedly through the pupil to the retina. This, the earliest of all Cataract Operations, is termed *Depression*, or Couching, the lens being pressed down into the vitreous humor.

2. By removing the lens bodily out of the eye, through a wound made for that purpose in the cornea: *Extraction.*

3. By taking advantage of the peculiar facility with which Nature, under certain conditions, dissolves and absorbs the entire substance of the lens; the Operation for Solution, or Absorption: termed also, from the modes of performing it, *Division* and *Discussion.*

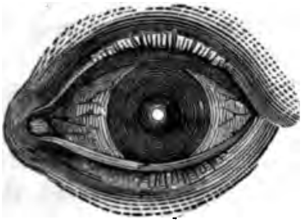


Fig. 28.

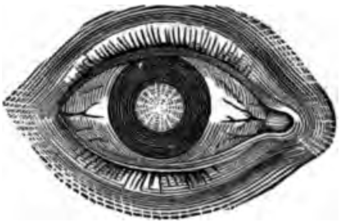


Fig. 29.

This is a disease of the eye which may be recognized by the loss of the *clear black* lustre of the pupil or sight of the eye, as may be seen by the above engraving. Fig. 27 represents a partial or incomplete cataract. Fig. 28 shows a complete and perfect cataract. It is a disease which ordinarily arises very slowly, and without any previous inflammation of the eye (unless it has been produced by accident). In its early stages it is likely to escape observation, unless closely and carefully examined; but after it has become fully formed, may be readily seen at a distance. It is a disease which completely destroys sight when it is fully formed, and its first symptoms are, a mistiness or fog before the sight, and a difficulty of recognizing persons or objects as usual. This continues to increase more or less rapidly, according to the nature of the case and the constitution of the patient, and may not become complete for months, or even for a year or two.

This is an important disease, and requires skilful hands to manage. It is seldom cured without an operation, though much relief may be given to the patient, during the formation of the disease, by local treatment. I have frequently, in such cases, enabled a patient to read large print, by an application to the eye, which has taken effect in ten minutes, though before the treatment they were unable to guide themselves. This improvement will continue for four or five days, and by repeating it, the effect may be continued during nearly the whole process of the formation of the cataract, and without experiencing the least pain whatever by the treatment. There is no medical treatment that will remove this disease after it has once commenced, or any other application to the eye that will stay its progress. Nothing short of a surgical operation, by skilful hands, will remove it, and undue proper management may be disposed of in a few days, with very little pain.

The loss of transparency (color) of the lens is accompanied by alterations in the cohesion and consistence of its fibres. These lose the gelatinous consistence, and become more or less fluid. The fluid is supposed to escape gradually through the capsule into the aqueous chamber, and to become absorbed. The size of the cataract, which at one time may have considerably exceeded that of a healthy lens (bulging the iris forward), becomes less. The cataract may shrink to such an extent as to give rise to tremulous iris, through the latter losing its support. The semi-transparent nucleus, after spontaneous absorption of the opaque matter, may become visible again.

The nucleus of cataract in old persons is generally large, flat, and slightly convex; while in middle-aged persons it is smaller, and more convex. Two bi-convex nuclei have been found in the same cataract.

The yellowish transparent, the brownish-gray, and the amber-colored nuclei are the most frequent.

The elimination of what is termed myeline is less marked among the fibres of the nucleus.

EXAMINATION FOR CATARACT.

The presence of cataract and its kind are best recognized by artificial light ("by local lateral illumination").

The patient (the pupil being dilated with atropia) is placed in a dark room, and the light of a lamp is concentrated in succession upon different parts of the lens, by means of a bi-convex lens of about 2-inch focus.

The faintest alterations in transparency can be recognized. The details of the opacities may be examined with a second lens. Opacities which, thus viewed, appear in their natural color, *e.g.*, gray and opaque, appear, when looked at with the ophthalmoscope, as black spots, streaks, etc.

The presence of cataract having been ascertained, we determine, as far as possible, its consistence (see *Consistence of Cataract*), and then the condition of the retina, choroid, etc.

Opacities in the vitreous chamber, blood-spots in the retina, anomalies in the color, curvature, etc., of the optic disk, can in many cases be recognized through less opaque portions of the cataract. After this, we test the retina for *its sensibility for light.* Complications with amblyopia are thus recognized. Experience must teach us the amount of light thrown through the cataract that can still be perceived by the healthy retina. Attention should particularly be paid to the sensibility of the most depending parts of the retina, these being more frequently impaired, especially in traumatic cataract, and in contact with myopia.

As regards complications arising from changes external to the eyeball, it may be remarked, that extraction of cataract has been successfully performed in patients with granulations, tinea, trichiasis, everted tear-puncta, or purulent discharge from the lachrymal sac.

Numerous enlarged vessels emerging from the sclerotic, near the cornea, always indicate some anomaly in the circulation of the choroid, and frequently glaucomatous changes. If cataract be coupled with increased tension, iridectomy should be performed some weeks previous to the removal of the cataract.

Opacities in the cornea may require iridectomy to carry the pupil behind transparent cornea.

A shallow anterior chamber is observed when a large "swollen" cataract displaces the iris forward.

A deep anterior chamber may be a sign of a small, shrunken lens, or of inflammatory changes of the cornea, such as occur in inherited syphilis.

A tremulous iris is not necessarily a sign of fluid in the vitreous chamber. Fluidity of the vitreous within the area of the retina, that within the area of the ciliary processes being normal, or the floating of a small, hard nucleus in a loose lens capsule, may cause it. Shrinking of the cataract, together with increase of aqueous humor, may cause the tremulousness. In cases with tremulous iris scoop, extraction with iridectomy (under chloroform) should be performed.

The *pupil* in every case should be dilated by atropia, previous to performing any operation. An iridectomy is performed if the pupil does not become dilated by atropia, or if the pupil is irregular from synechiæ.

We must not neglect to ascertain the *shape of the eyeball.* Small or hypermetropic eyes frequently present glaucomatous complications. Myopic and large eyes often contain fluid in the vitreous chamber, and present retinal and choroidal complications. Great protrusion of one eye, or of both, may exist without any morbid changes of the tunics.

Causes.—(1.) Injuries (perforation of the tunics, or mere concussion of the eyeball) may at any age produce catar ct of the injured eye.

(2.) Altered nutrition occurring in the course of morbid changes of surrounding tunics, especially after choroido-iritis (so-called Secondary Cataract). The opacities caused by iritis are generally circumscribed (gray-white dots or streaks), and situated immediately beneath the anterior capsule. Serous effusion behind the iris and glaucoma give rise to diffused opacity, and to increased density of the lens.

Posterior polar cataract frequently occurs in myopic persons. Anterior polar cataract in children who have had purulent ophthalmia with corneitis.

A peculiar form of cataract (the green and black one) arises from deposit among the lens fibres of hæmatin and other coloring matters.

Cataract (the consistence of which varies according to age) is often observed in both eyes of persons who suffer from diabetes mellitus, or who have taken secole cornutum for a prolonged period, and not unfrequently in females during suckling. In the latter case it generally remains confined to one eye.

Congenital cataract most frequently occurs in children suffering from inherited syphilis.

Cataract in old persons (senile cataract) is attributed to impaired nutrition of the fibres of the lens, and to anomalies in the permeability of its capsule.

CONSISTENCE OF CATARACT.

The treatment of cataract would vary but little if its consistence were the same in all the cases. If every cataract were fluid, we should uniformly remove it by suction. If all cataracts were hard, we should have to deal with them by the more hazardous operation for extraction.

The consistence of the healthy lens varies according to age. Up to the age of thirty-five it is glutinous. About that time a difference becomes apparent between the central and the more superficial portions. The former become more yellowish, and are termed the nucleus. Large, hard nuclei have, however, been extracted from the eyes of persons aged from twenty to thirty (after iritis). In rare cases the change from glutinous consistence to hardness extends throughout the lens. The hard nucleus is rarely opaque, but generally yellowish and translucent. A complete absence of nucleus is in old persons extremely rare. The nucleus is generally surrounded by opaque lens matter. The latter varies in consistence, and is not unfrequently fluid, or so soft that the nucleus sinks into it.

If the nucleus floats, it gives rise to tremulous iris, and during movements of the eye rolls about in the opaque fluid. The sinking of the nucleus is always a sign of softening of the surrounding lens matter. It can frequently be recognized by examination with the ophthalmoscope, the pupil being well dilated, when the reflection peculiar to the nucleus is perceived, not in the centre, but near to, or at the lower margin of, the cataract. The sinking of the nucleus is thus far favorable—that, together with the soft matter, it can be removed through a smaller incision.

We distinguish four varieties of consistence, and as many forms of cataract:—*the fluid, the soft, the glutinous, and the hard cataract.*

The *fluid cataract* is white or gray, or yellowish-white and uniformly opaque, and, as a rule, without gray and opaque streaks or dots. An abundance of particles of lime settling at the lower half of the capsule may, however, give rise to a difference of color, this part appearing more intensely white and opaque. The movements of the eye cause the chalky fluid to mix with the rest, and for a time to impart to the cataract a uniform white color.

The change into fluid commences at the surface nearest the capsule, and rarely extends over the entire lens. Often a brownish hard, small, well-defined nucleus floats in the fluid.

A rare form of fluid cataract is a change of the lens into a yellowish, nearly transparent, oily liquid. All fluid may become absorbed, and merely particles of lime remain attached to the thickened capsule. The fluid readily escapes if the capsule is punctured.

Third cataract is frequently congenital, and has been observed at all ages.

The Soft Cataract.—We must distinguish between the kind of cataract which, when incising the capsule, in great part escapes spontaneously (it is generally termed soft cataract), and the kind which is described as *gelatinous cataract*. The softening, as a rule, commences at or near the capsule. In rare instances it occurs first in the centre, which then appears bluish-white and opaque, shading off into more translucent opacities dispersed through the superficial layers of the lens.

Examination with the ophthalmoscope shows that in soft cataract the marginal parts appear more opaque than in the centre, if the nucleus is transparent; while the opacity is densest in the middle, if the nucleus is also opaque.

The cortical substance may be considered soft—

(1.) If the opacity reaches up to the capsule ("to the margin of the pupil"). (2.) If the cataract has a white and opaque color, its surface being dotted over with ill-defined (diffuse), irregular-shaped opacities; or with broad, ill-defined, and opaque streaks. (3.) If in the eye with cataract (supposing only one eye is affected) the iris is pushed forwards, and the pupil slightly dilated and not very movable.

Cataract in persons below thirty-five, presenting the above signs, is, as a rule, soft throughout. The older the patient, the more must we expect to find a hard nucleus, of varying size, surrounded by soft cortical substance.

The gelatinous or glutinous cataract has the consistence of the crystalline lens in health. No lens matter, or only a little, escapes after incising the capsule. It is difficult to recognize this kind of consistence, if no opaque streaks are visible. The narrower these streaks are, the more glutinous is the cataract.

It is glutinous—(1.) If the layers of the lens nearest the capsule are transparent or semi-opaque, so that we can to a certain depth look into the cataract. (2.) If narrow and opaque streaks alternate with transparent lens substance.

The cataract following choroido-iritis in young persons is often gelatinous; so also is the one described as lamellar cataract.

The hard or senile cataract derives its name from the hard consistence of the "nucleus," while the portions of lens nearest the capsule are, as a rule, more or less soft. The cataract frequently commences in the portion of the lens near the nucleus, while the latter remains brownish-yellow, and semi-transparent. The nucleus often becomes smaller, while the superficial (fluid or soft) and opaque lens matter becomes absorbed.

The term *lamellar cataract* has lately been introduced, to designate a lens in which opaque layers of lens fibres alternate with transparent ones; *e.g.*, the nucleus and the lens fibres immediately beneath the capsule may be transparent, while the intermediate parts of the lens are opaque or semi-opaque. The opacity, in this case, is more intense near the margin of the lens. On examination with the ophthalmoscope, we observe a reddish reflection from behind the cataract, when looking through its middle (the light returning through the transparent centre of the lens), which would not be the case if that part of the lens were opaque.

The appearance of diffused opaque streaks and dots immediately beneath the capsule indicates an increase of the cataract. The opaque layer often shrinks, causing the lens to become smaller. Other parts, in their turn, become opaque, so that, at the age of thirty, we may find the lens opaque throughout, while at the age of twenty-five it had the appearance of lamellar cataract.

Another form of lamellar cataract is the one in which the anterior or the posterior half, or lateral portions of the lens, appear opaque and shrink, while the rest remains transparent. Lamellar cataract, when stationary, should be removed, if the patient can only read large type. An artificial pupil should be made if, the pupil being dilated by atropia, ordinary type can easily be read. At the same time, the patient must be told of the probable "increase" of the cataract.

The Striated or Streaked Cataract.—Gray or white and opaque striæ, or streaks, appear first at the margin of the lens, beneath its capsule. Here they are broadest, and extend over both surfaces of the lens, and frequently first over the posterior. In the latter case, we find in a more advanced stage an opacity with radiating striæ, which, seen through the transparent bulk of the lens, appears concave and deep-seated. Sooner or later, the striæ extend over both surfaces of the lens. The opacity may extend over the entire surface which lies next the hyaloid fossa, before any striæ appear on the anterior surface. Narrow gray and opaque, or moderately broad, but white and opaque, striæ are made up of opaque lens fibres of nearly normal consistence and cohesion, surrounded by healthy lens fibres. Striæ of similar size, but of a grayish opalescent color, are softer, and less coherent. If the striæ are broad, and the intervening lens substance is opalescent, with the iris pushed forwards and but slowly moving over it, we suppose the cataract soft throughout.

The "*Black Cataract.*"—This rare form (the entire lens having a black or deep-brown color) has been found in eyes in which hemorrhage has occurred in the vitreous chamber. Each lens fibre, when the cataract is examined minutely, appears transparent, but has a yellowish-brown tint. The brown substance chemically resembles the coloring matter of blood.

Different from this form is the senile cataract with a reddish-brown, or amber-colored, or black nucleus, which occurs frequently.

The "green" cataract has been observed between the ages of forty and eighty in persons with strongly-pigmented irides. The lens, though nearly transparent, has a dark pea-green color while within the eye, and a light yellowish-brown one when removed from it. The optic disk, viewed through the lens, appears hazy. The removal of this kind of lens is accompanied by improvement of vision. The absence of glaucomatous symptoms distinguishes this kind from the greenish lens of many glaucomatous eyes.

The *chalky cataract* has a characteristic dead-white, or yellow-white and opaque color.

The following are the usual forms:—

(1.) A flat, irregularly-shrunken, somewhat disk-shaped, stony, hard cataract.

(2.) A cataract consisting of a shell of chalk, enclosing opaque lens matter, bloodvessels, and cholesterine crystals. In rare cases the nucleus becomes changed into chalk.

(3.) A lens changed into a chalky fluid, the heavier particles gravitating towards the most depending portions of the capsule.

Chalk in the form of minute white granules, or in groups of granules, or spiculæ, is found deposited on the surface of many transparent or opaque lenses. The lens capsule of the fluid variety is much thickened; in the other varieties it is extremely thin. Minute and chemical examination of the cataract shows that it consists of carbonate and phosphate of lime, of cholesterine crystals, and of fat.

This kind of cataract is, as a rule, complicated with atrophic changes of the choroid, retina, etc. It has, in rare cases, been observed with a healthy retina, but with fluid in the vitreous chamber.

Spicules or shells of true bone with bloodvessels have, though rarely, been found within the capsule of the lens.

Cataract in diabetic persons is soft in young, and combined with a hard muscle in old, diabetics. Choróidal or retinal combinations are comparatively rare, while paretic or paralytic affections of the ciliary muscle are frequent.

The cataract generally has an opalescent surface, and is swollen, pushing the iris forwards.

In young persons it may be removed by suction; provided it be, or have been, rendered quite soft.

Persons in the last stage of diabetes, who have had both eyes operated on simultaneously, have recovered good vision. Cataract without complication, *i.e.*, without morbid changes in other tunics, is termed *primary;* such may be the traumatic, the idiopathic, and the congenital cataract. *Secondary cataract* exists if morbid changes of the "vitreous," "choroid," etc., can be traced as the cause.

VISION.

Most of the complaints of persons suffering from cataract can be traced to the cataract interfering with the course of the rays of light through the crystalline lens: some to changes in the refraction and accommodation; others to amblyopia or amaurosis.

Black spots floating before the eye—dimness, or a mist which is not removed by spectacles—intolerance of light, obliging the patient to shade the eyes or to turn the back to the light, to be able to see small objects better—are complaints often heard from persons suffering from incipient cataract. Numerous small, ill-defined opacities cause much dazzling or diffusion of light, which is relieved by the use of spectacles with tinted glasses. A dark disk-shaped figure, with its centre somewhat clearer, and surrounded by a more transparent portion, has been described by some patients suffering from lamellar cataract. In such, vision has been improved by the use of atropia.

In senile cataract with semi-transparent nucleus vision may improve gradually through spontaneous absorption of the opaque superficial "lens matter." It may improve suddenly through spontaneous displacement of the cataract from behind the area of the pupil.

Flashes of light of various colors, fiery circles, "falling stars," if observed in daylight, may be caused by the light, on entering the eye, impinging upon peculiarly placed particles of cataract. Morbid changes in the nervous apparatus of the eye, especially if these symptoms are observed in the dark, are, however, the usual cause. They frequently occur in myopic eyes, and are then of less consequence.

Careful examination of the sensibility of the retina for light and ophthalmoscopic examination must decide how far these symptoms should influence our treatment. Pain in the ciliary region and over the "eyebrows," or a sensation of "grit" in the eye, are frequently complained of by hypermetropics with commencing cataract.

Vision after Removal of Cataract.—Spectacles are required to give the patient the best possible degree of vision, whether one eye has been operated upon or both. Refer to page 49.

TREATMENT FOR CATARACT—GENERAL REMARKS.

We inquire into the state of the general health of our patient, and treat medically any morbid changes we may discover. Syphilis, affections of the kidneys, atheromatous changes in the arteries, etc., very much influence the final success of operations for cataract.

Thin, quiet persons with soft skin are the most favorable for extraction. Suppuration is frequently observed to follow in those with very white hair and rigid arteries ("with a hard, large pulse").

Persons suffering from syphilis, gout, delirium tremens, asthma (emphysema), bodily deformities, have been successfully operated upon by extraction. Extraction with iridectomy (with the smallest possible incision) should be adopted in persons with cough, or with infirmities which prevent their remaining in bed for a few hours in succession.

In different quarters a local medical treatment has been recommended for the dispersion or for the arrest of the cataract. As far as I could learn, the remedies used for the purpose have contained iodide of potassium. The following is a copy of a prescription used by some Continental oculists for dispersion of cataract:—

℞. Potassii Iodide, ʒvj.; Tincture Conii et Misturæ Oleosæ Balsamicæ, āā, ℥iij. From 12 to 15 drops to be rubbed over the eyebrow four times daily.

I have accurate notes of two patients, one a lawyer, who used the remedy for the last three years, and followed his occupation, which he could not do when I saw him for the first time; and the other a lady who is much engaged in reading, near work, etc. In both cases the opacities have become whiter and smaller.

The Age of the Cataract.—Cataracts from thirty to sixty years old have been removed with good result. Vision has improved much after removal.

The Age of the Patient.—Persons aged ninety and ninety-four have been operated on successfully by extraction on both eyes simultaneously. The habits of aged people are hardly disturbed by the operation of extraction with iridectomy and with a small corneal incision.

The Season for Extraction of Cataract.—Cold or rainy weather is less favorable, since it prevents patients from taking outdoor exercise after the operation. Hot weather (especially hot nights) prevents many patients from sleeping, and suppuration seems to appear more readily. Spring and autumn are the most favorable times; though otherwise healthy persons may, with perfect safety, be operated on at any time of the year.

REMOVAL OF CATARACT FROM ONE EYE ONLY, THE FELLOW-EYE POSSESSING USEFUL VISION.

The advantages of removing the cataract are, that the field of vision becomes larger, the judgment of distances and shapes of objects more perfect, and the patient can more readily guard against accidents. Diplopia rarely follows, or soon disappears. Strabismus does not necessarily occur, and may as easily do so if the cataract is not removed.

The cataract, age and circumstances permitting, should be removed by absorption, or by a small corneal section, with iridectomy. Vision of the eye operated upon should occasionally be practised separately, with an appropriate convex lens.

Removal of cataract from an eye which has not perception of light has often been performed with success—(1.) For reasons of personal appearance, *e.g.*, if there is chalky cataract. (2.) For sympathetic irritation of the fellow-eye caused by, or attributable to, a dislocated chalky or other cataract. (3.) In blind eyes, the tension of which is too great, and not the result of intraocular tumor.

Both eyes have frequently been operated upon simultaneously by extraction, with good result. Cases, however, have occurred in which both eyes have been lost. It is a safer plan to operate on the second eye a week after the first. In selecting the mode of operating, we must be guided by the accidents, etc., which may have happened during the first operation.

OPERATIONS FOR THE REMOVAL OF CATARACT.

Removal of Cataract by "Extraction."—The object of the operation is to remove—"extract"—the cataract through a large incision in the cornea, or in the sclerotic close to, and in front of, the insertion of the iris.

Many surgeons combine an iridectomy with every operation for hard cataract; others confine iridectomy—(1.) To eyes with posterior synechiæ; (2.) To cases in which suppuration of the flap of the cornea is likely to happen; (3.) To traumatic cataract in old persons; (4.) To cataract with a very large, hard nucleus; (5.) To cataract in which the superficial part of the lens is of normal consistence; and (6.) To dislocated lens.

OPERATION.

The patient is put to bed, lying on the back, and facing the light, with the head slightly raised, and the hands watched by an assistant.

The surgeon sits or stands behind, and, *e.g.*, when operating upon the right eye, places the tip of the forefinger of the left hand upon the middle of the outer edge of the margin of the upper lid, and gently raises the lid above the margin of the cornea by causing it to glide along the curvature of the eyeball. Slight pressure is then made upon the eyeball with the tip of the forefinger, and with that of the middle finger upon the side of the eyeball near the inner margin of the cornea. This much control is obtained over the movements of the eye. An assistant draws down the lower lid, and presses it against the malar bone, without touching or dragging the eyeball.

Some surgeons keep the eyelids open with a light stop-speculum, and fix the eye with the forceps. If the stop-speculum is used, it should be carefully removed after the incision is completed.

Others raise the upper lid as just stated, while an assistant fixes the eye with the forceps at the insertion of the inferior rectus, draws it down, and at the same time depresses the lid.

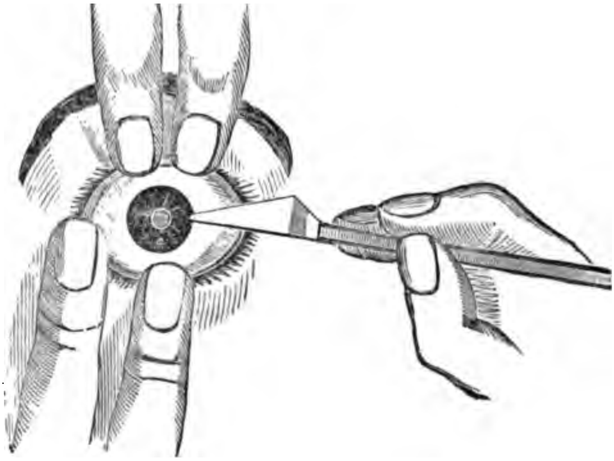


Fig. 30 represents extraction of the superior section of the cornea.

The forceps are removed shortly before completing the corneal incision.

Having secured the greatest possible control over the eyelids and eyeball, the cataract-knife is taken into the right hand. The thumb is placed on one and the fore and middle fingers on the other side of the handle, near the spot where it joins the blade. The little finger of the same hand rests upon the patient's face. The point of the knife is thrust through the cornea at its junction with the sclerotic, and a little above the point where its horizontal meridian touches the sclerotic. The knife is steadily pushed across the anterior chamber, the blade remaining as much as possible parallel with the iris. The point of the knife is again thrust through the cornea, about opposite the spot where it entered.

The cutting-edge of the knife, while making the incision, is directed towards the upper margin of the cornea, and the incision is completed by a to-and-fro movement of the blade, without allowing the point to return into the aqueous chamber. The line of incision, if well made, should be parallel with the margin of the sclerotic. A crescentic flap should be formed, which comprises nearly the upper half of the cornea. The size of the corneal flap depends upon the size of the hard nucleus, which we should ascertain as nearly as possible. The flap should always be sufficiently large to allow the nucleus of the cataract to escape with the greatest ease. The incision must be completed very slowly, and at a moment when there is no straining on the part of the patient, and no pressure whatever exercised upon the eyeball.

The incision being completed, the lids are released and gently closed.

After a minute's rest, we proceed to the laceration of the anterior capsule. An assistant draws down the lower lid while the operator carefully raises the upper lid. The patient is directed to look downwards ("towards his hands"). The operator with the right hand introduces the pricker through the wound in the cornea (raising the latter as little as possible, and without touching the iris), to opposite the middle of the pupil.

He then directs the point of the pricker towards the cataract, and, without displacing the cataract or pressing hard upon it, pierces the capsule and makes several incisions into it, so as to lacerate an area which is about equal in size to a moderately dilated pupil. No resistance is felt in incising the capsule, unless it be thickened. In rare cases, the thickening is so considerable that the pricker cannot pierce it; in which case, a sharp hook must be used to withdraw as much of the capsule as will follow. Sometimes cataract and capsule can thus be removed together. (The removal of the capsule, or cataract and capsule, with the sharp hook, should always be attempted.) The capsule having been opened, we again "drop" the lid for a few seconds, and then proceed to the removal of the cataract.

Experience is required as regards the necessary amount of pressure upon the eyeball to cause the cataract to escape. To do this, we place the flat part of the scoop upon the lower lid, near its margin, while the patient looks downwards. We then press with the scoop gently upon the sclerotic, the top of the forefinger of the left hand, which keeps the upper lid raised, being placed upon the eyeball. Careful alternating pressure is now made upon the eyeball in these two parts. This should cause the cataract slowly to advance into, and through the pupil, and through the incision in the cornea. As soon as the greatest diameter of the cataract lies in the section, we cease pressing. The margin of the lid, or a finger, or the scoop, is used to remove the cataract from the section. After the nucleus has escaped and been removed, we close the lids gently, and allow the patient to rest a minute. By placing the tip of one finger upon the closed upper lid, and gently rubbing the lid against the cornea, we cause the soft part of the cataract, accumulated behind the iris, to advance into the area of the pupil. We then raise the lid, and carefully remove the soft parts of the cataract with the scoop. Some of the soft cataract may be left, if the iris shows much tendency to bulge; the pupil, however, must be afterwards kept well dilated by atropia. The lids of both eyes are then closed carefully with narrow strips of sticking-plaster, and two pieces of lint, dipped in cold water, are tied lightly over the closed side of each eye.

Accidents during the Operation.—(1.) The aqueous humor may escape too soon. This happens if the knife is not well made, or if it is steadily pushed on while making the section, or during a sudden movement of the eye. In these cases we withdraw the knife, and complete the section with strong, blunt-pointed, strabismus scissors. Corneal incisions, thus made, heal readily. If we do not wish to withdraw the knife, and the iris places itself over the edge of the knife, we gently press with the forefinger (which assists in raising the upper lid) upon the cornea. The pressure is kept up until the section is almost completed. If the iris cannot be pushed back, we cut through it, or withdraw the knife, and finish the section with scissors. If the iris has been much bruised, we exercise the bruised portion.

(2.) If the margin of the pupil, or some other portion of the iris, has been wounded, bleeding occasionally occurs into the aqueous chamber. This is of little consequence, unless the iris has been bruised, when the bruised part should be exercised, to avoid iritis.

(3.) If a second pupil has been formed, by some marginal portion of iris having been cut away, the intervening bridge of iris must be divided with scissors before opening the capsule. We thus avoid the cataract becoming entangled in the new pupil.

(4.) The iris, having completed the corneal section, may "bulge," *i.e.*, may project slightly, and push the margins of the corneal incision asunder. This, if posterior synechiæ exist, may be caused by aqueous humor accumulated behind the iris. An iridectomy should be performed.

If the apparently healthy iris "bulges," there being neither straining nor pressure upon the eye from without, we must be prepared for a troublesome course. The bulging is the result of undue tension of the eye, and escape of vitreous, etc., threatens.

The patient must be particularly careful, during the further steps of the operation, not to strain; and all pressure upon the eye should be avoided.

If in these cases we perform iridectomy of the bulging portion of the iris, the greatest delicacy is required lest vitreous be lost.

The Cataract may not Escape.—(1.) From the corneal incision being too small. The incision may be too slanting, or generally too small, so that even much pressure does not cause the cataract to escape. The incision must be enlarged (with strong, blunt-pointed scissors) if the cataract does not escape readily.

(2.) From the pupil not dilating, if, previous to the operation, the pupil resists atropia, iridectomy should be performed before opening the capsule. This accident rarely happens—it is observed in highly presbyopic persons, and in persons suffering from cerebral changes, *e.g.*, from the effects of apoplexy. Both pupils are generally contracted, and resist the action of atropia.

(3.) From being adherent to the capsule,—as has been observed in cataract with dead-white superficial spots, and in traumatic cataract. Removal of the capsule with the sharp hook becomes necessary.

"*Vitreous*" *Substance may Escape.*—(1.) Before the cataract is removed, sometimes even before the capsule has been lacerated. This may occur if the section is carried too near the ciliary processes, if the patient strains much; or after the capsule is opened, if too much pressure is made upon the eye. The vitreous in these cases bursts through the suspensory ligament, and the cataract sinks back behind the iris. To prevent this, the scoop should be rapidly carried through the pupil, behind the iris and cataract. The latter must be removed, however much "vitreous" may be lost. Loss of vision, through glaucomatous changes or suppuration of the eyeball, follows if the cataract be allowed to remain in the vitreous chamber.

(2.) "Vitreous" may escape with the cataract, or immediately after its removal, through straining of the patient, or through too sudden completion of the section.

The lids should at once be closed, and a sponge, dipped into cold water, placed upon them. After a few moments the lids are raised carefully, to see whether the corneal flap is doubled down. If so, we pass the curette gently beneath the slightly raised upper lid, and along the curvature of the cornea, so as to bring the flap into a more natural position; having succeeded in this, we at once close the lids, and apply a bandage with wet lint.

The cataract escapes enclosed in its capsule, if too great pressure is made upon the eye, or if the patient strains much. This is of no consequence if no "vitreous" is lost. The unfavorable consequences, if vitreous is lost, may be—partial displacement of retina,—hemorrhage between choroid and sclerotic, more particularly in the region of the ciliary processes, followed by more or less shrinking of the eyeball, or more or less severe inflammation.

"Vitreous" may escape though there be no straining, and no fault committed by the operator.

(1.) This, if the "vitreous" has the natural consistence, or is too firm, is a sign of the eye being glaucomatous. Due regard to the tension may assist us in avoiding this grave accident. It occurs more particularly in persons with very large and hard arteries, and in persons with very white hair. The iris bulges, and the cataract escapes as soon as the corneal incision is finished, or immediately after the capsule is opened; "vitreous" follows immediately, or a few seconds later. The patient at the same time complains of severe pain in the eyeball, which is caused by sudden displacement of the ciliary nerves. Blood oozes out through the corneal wound as soon as all the vitreous has escaped. On making a section of the eye, we find the retina and choroid separated from the sclerotic (except at the optic disk, and near the ciliary muscle) by coagulated and fluid blood. The accident has repeatedly occurred in both eyes. Vision is lost; and the eye, if not removed at once, remains often painful for weeks, until it gradually shrinks.

(2.) If the "vitreous" is fluid and the tunics collapse, little need be feared. It is only when the curvature of the tunics remains unaltered that intraocular hemorrhage need be expected. The tunics of both eyes may collapse completely, and be thrown into folds, without their relative position being disturbed. All fluid occupying the vitreous chamber may escape; and twelve hours later, we may find the natural curvature of the tunics restored, through fluid again filling the vitreous chamber. Good vision is generally obtained. In these cases, after the cataract is removed, some wet lint, dipped into tepid water, should be tied over the closed lids, so as to exercise very slight pressure, while the patient, for from 24 to 48 hours, is kept in bed.

(3.) The area of the pupil remains gray and opaque, though soft portions of cataract having been left after removal of the nucleus. The more glutinous the soft parts of the cataract is, the less readily does it escape. If it does not come away easily by using the syringe or the scoop, no further attempts at removal should be made. We must be prepared for iritis, or for a more protracted recovery. Particles of the nucleus, if soft and left behind, may become absorbed without further disturbance; if hard, they often cause iritis (within 24 to 60 hours), which reaches its height from the fourth to the seventh day after the operation. We must prepare for this if, from the irregular shape of the hard nucleus, we infer such particles to have remained behind.

TREATMENT AFTER THE OPERATION, SUPPOSING NO ACCIDENT TO HAVE OCCURRED.

The patient should occupy a well-ventilated room, which is still sufficiently light to allow of our seeing the color of the skin of the eyeball, and applying the wet lint securely.

The patient is placed in the position which is most comfortable, and is told to avoid undue muscular effort, and all unnecessary movement. The uppermost piece of wet lint is changed every quarter of an hour until bedtime.

The patient should be prevented, for the first five days, from touching the eyes during sleep, by having the bed-covering stitched to the pillow, allowing sufficient room to turn round, but not to bring the hands up to the face. Should this be found inconvenient, the patient must be watched for four or five nights. The wet lint placed on the lids is secured with a bandage during sleep.

Restless persons may require a narcotic. The patient has to remain in bed for from 36 to 48 hours. The next five days he may remain up a few hours in the middle of the day, having the lids bound up with wet lint. The application of wet lint is repeated frequently during one hour after breakfast, and during several hours before going to sleep.

No food requiring mastication is allowed during the first twenty-four hours. Broth, beef-tea, wine, eggs, vegetables may be given; and solid animal food (finely-minced meat) on the second day. Spirits or beer may be allowed to those who are in the habit of having them.

The outward appearance of the lids, the quality of the discharge, and the presence of pain, are the guides which we have as to the necessity of examining the eye.

The eye is doing well if the color of the lids (especially of the upper lid) is not changed, or their margins only slightly reddened; and if there is only slight watery or mucous discharge, and no pain. In this case, we inspect the eye on the eighth day after the operation. The incision frequently has healed on the second or third day.

We may find—(1.) slight or no redness of the conjunctiva; the incision healed, and the line of incision smooth, or very slightly uneven; the anterior chamber good, and the pupil clear and central, or slightly displaced towards the section.

(2.) Or we may find all as just mentioned, except no anterior chamber, the iris resting against the cornea. In this case a bandage is applied over the closed eyelids *until the section has healed completely* and the anterior chamber has become restored. In rare cases, four or six weeks may elapse before the union is complete.

(3.) We may find some sclerotic redness, the pupil occupied by opaque matter, and all other parts healthy; in which case a bandage over the closed lids and atropia are made use of, the latter being applied every third hour during the day until the pupil appears clear, or nearly so. The eye operated upon may be used as soon as all sclerotic redness and intolerance of light have ceased. A shade must be worn, or the eye kept closed and not exposed to bright light, as long as there is the slightest intolerance of light.

Atropia is applied to the eye not operated on, once daily.

Twenty-four hours after the operation it may be allowed to remain open with a shade over it. It must again be closed if keeping it open gives rise to uneasiness.

This favorable progress of the eye operated upon is, by no means, the rule. Generally a pricking sensation or pain is complained of for a few hours after the operation, especially when moving the eyeball. The pain ceases, or is temporarily relieved, by escape of tears.

Lint dipped in cold water must, in this case, be applied more frequently to the closed lids, even until late at night. The frequent application of wet lint, if pleasant to the patient, is continued on the following days.

Swelling and redness of the lids, and pain in the eye or "over the eyebrow," are certain signs of undue inflammation. We must, wherever they appear, carefully (and without exposing the eye operated upon to more than is necessary) inspect the cornea and iris.

We may find—(1.) prolapse of the iris. This is readily recognized by a change in the curvature of the cornea. The margins of the incision are not in apposition with each other, but are pushed asunder by a dark substance (the iris next the section) which projects more or less. The pupil is drawn up, and often disappears behind the margin of the cornea.

It much depends upon the general health of the patient, and upon the condition of the eye previous to the operation, whether the prolapse (being a great source of irritation) gives rise to inflammation, and if so, to what kind. If left alone, the prolapse generally disappears spontaneously, accompanied by great pain and prolonged irritation. It should, however, as soon as its presence is ascertained, be either treated by—

(*a.*) Puncturing and then touching with the solid nitrate of silver. This is useful if aqueous humor or swollen particles of cataract are in contact with the bulging iris. Touching with caustic has been followed by severe inflammation, if the prolapse has been caused by protrusion of "vitreous." Pressure upon the closed lids, by means of a bandage and wet lint, must be kept up for several weeks. The operation of puncturing and touching with caustic may have to be repeated if the prolapse has not subsided after one application.

Only—

(*b*.) Snipping off the prolapse with scissors. This, if followed by loss of vitreous or by fistula, may lead to shrinking of the eye. A satisfactory result has in many cases been obtained (especially where the pupil has been much displaced towards the section), by first (under chloroform) "making an artificial pupil" downwards, supposing the prolapse to be upwards, and then by removing the prolapse with forceps and scissors. In doing this, care must be taken to leave a narrow rim of iris along the base of the prolapse, to secure ready union. After the operation both eyes are kept bound up with wet lint; the lint has to be changed frequently until the anterior chamber is restored.

(2.) We may find the incision healed, its margin hazy, the aqueous humor slightly turbid, the pupil somewhat irregular and occupied by opaque matter, the tension of the eye normal or slightly increased, and perception of light normal. Locally, we treat as in iritis, *i.e.*, order four or six leeches to be applied to the corresponding temple, if the pain is at all considerable, and atropia to be used every second hour during the day. Lint dipped into cold or warm water (according to the feelings of the patient) is applied frequently to the closed lids of both eyes.

Suppuration of the incision may set in even as late as two or three weeks after the operation. It may occur while union is going on, or after it is completed.

(3.) Suppuration may extend from the incision. The cornea becomes gray, or yellowish, and opaque. This is accompanied by increased swelling and redness of the lids; by chemosis, especially round the incision, with more or less muco-purulent discharge; by pain in the eye and over the corresponding side of the head, etc. The suppurative inflammation subsides in about eight weeks, if it remains confined to the cornea, and cornea and iris. The cornea remains opaque and adherent to the iris; part of it may recover its transparency. If the cornea sloughs a cicatrix follows, which sometimes becomes staphylomatous.

The patient retains perception of light. The suppuration sometimes extends to the "vitreous," choroid, and retina.

The suppuration may commence in the ciliary processes and in the adjoining vitreous, and thence extend. A yellow reflection from behind the pupil indicates the presence of pus. Suppuration of the iris and cornea soon follow.

In rare cases a form of cornea-iritis appears, which resembles the one in persons who suffer from inherited syphilis, and should be treated as such.

In old or badly-nourished patients suppuration of the cornea may appear without any, with little swelling of the lids, and with severe purulent discharge from the conjunctiva. In such, when examining the eye on the second or third day after the operation, we find chemosis, and the cornea changed into a yellow opaque substance. The eye gradually shrinks.

By the frequent application of lint (dipped into warm water) to the closed eyelids, and by generous diet, we may succeed in confining the suppuration to the cornea, and in retaining good perception of light.

REMOVAL OF CATARACT BY THE SCOOP.

("BY TRACTION")—*Scoop Extraction.*—The object of this mode of operating is to remove the cataract with the aid of a scoop, through a smaller incision in the cornea than is made for common extraction. The removal of the cataract is preceded by iridectomy.

The advantages are:—(1.) That we can give chloroform with greater safety, as regards the eye. (2.) That we avoid the complications arising from prolapse of the iris, and derive the advantages of an iridectomy as regards the tension of the eye. (3.) That the cataract can be removed more completely.

The disadvantages of an irregular pupil, if the iridectomy be not made upwards, can partly be counteracted by properly-arranged spectacles: the iridectomy, if made upwards, creates but little inconvenience.

Operation.—The patient, being under the influence of chloroform, is placed as for the extraction of cataract. The eyelids are kept open with a light stop-speculum, and the eyeball is fixed with the forceps opposite to the point where we propose commencing the incision. The incision should have a length of from three to five lines, according to the size of the nucleus of the cataract. It should always be large enough to allow of easy removal of the cataract.

It should commence in the sclerotic, at the margin of the cornea; its extremities should lie in front of the iris, in the sclerotic adjoining the cornea. Those who are in the habit of performing eye operations make the incisions along the upper margin of the cornea; it is, however, easier to make it along the outer margin. The straight, or the bent lancet-shaped knife (largest size), the point entering at the extreme margin of the anterior chamber, is steadily pushed on into the anterior chamber (the point being directed very slightly forwards), until the incision has the desired length. Should the point have reached the opposite cornea before this is attained, then the incision is enlarged while withdrawing the knife, or afterwards with strong, blunt-pointed scissors. Care should be taken not to wound the iris or the capsule of the lens.

Iridectomy is then performed. The portion of iris exercised should be sufficiently large to prevent our bruising the remainder during further manipulations. Blood in the chamber should, as far as possible, be removed before proceeding to the laceration of the capsule and to the removal of the cataract.

During the removal of the cataract the patient should be thoroughly under the influence of chloroform.

The aqueous humor having escaped and the iridectomy having been performed, the operator fixes the eye himself, and, with the sharp hook or the pricker, proceeds to the opening of the capsule.

The sharp hook (or the pricker) is passed through the incision over the surface of the capsule to the spot where we wish to make the first opening. It is best to lacerate the capsule, first, along the margin of the lens which lies farthest from the incision. There the point is thrust through the capsule. Afterwards the other portions of the capsule are freely lacerated. To do this, without wounding other parts, we must be familiar with the shape and size of the lens. While opening the capsule we must neither bruise the iris nor displace the cataract. The part of the capsule next the incision is opened last. We sometimes succeed in withdrawing the capsule with the sharp hook.

While opening the capsule attention should be paid to the consistence of the cataract, and to the size of the nucleus. The spontaneous escape of soft, opaque matter should be encouraged by gentle pressure upon the eyeball.

The nucleus can often be removed by passing the sharp hook behind, and into it, and then withdrawing it. The sharp hook must be withdrawn if we do not readily succeed in removing the nucleus of the cataract, and the scoop must be made use of. If the pricker is used for lacerating the capsule, we withdraw it, after having freely opened the capsule, and, if necessary, loosened the nucleus.

Knowing the size, shape, and position of the nucleus of the cataract, our next object is to pass the scoop between the capsule and the nucleus. Having succeeded in passing the scoop through the wound in the cornea, and, through the pupil, into the cataract and behind the nucleus, we gently press the scoop and nucleus forwards into the area of the pupil, and then slowly withdraw both from the eye. During these manipulations *all pressure upon the iris and cornea* should be avoided.

The entire nucleus having been withdrawn, we remove the speculum, close the lids, and gently rub the upper lid over the cornea, so as to cause softer portions of cataract, which may have been left behind the iris, to advance into the area of the pupil. If any are visible, we remove them with the scoop or syringe, as in extraction of soft cataract. Portions of the nucleus are sometimes broken off, if the incision has been made too small, or too much force has been used while withdrawing the nucleus. This must be ascertained by examining the nucleus which has been removed. All particles of the nucleus should be removed with the scoop.

Accidents during the Operation.—(1.) If the incision is too small to allow the scoop, or the scoop and nucleus, to pass, the scoop must be withdrawn and the incision enlarged with the knife, or with scissors, after which the scoop is reinforced, and the nucleus removed.

(2.) The scoop, instead of passing behind the nucleus, may push the entire cataract towards the opposite side. Insufficient opening of the capsule (especially if thickened), or a glutinous (normal) consistence of the superficial portion of the lens, or insufficient loosening of the nucleus, may cause this. The scoop should be withdrawn, the capsule opened freely, and the nucleus freed with the sharp hook or pricker.

(3.) Portions of the nucleus may be broken off, and left behind, especially if force has been used while withdrawing the nucleus. We should endeavor as much as possible to remove these portions with a small scoop, and, if unsuccessful, take the necessary steps to prevent the occurrence of inflammation; apply leeches, though there may be no inflammation as yet, etc., etc.

(4.) Vitreous may escape before the capsule has been opened. This may happen if the incision is made too far behind the margin of the cornea, or it may occur immediately after iridectomy (if the patient is straining), or while attempting to introduce the scoop behind the nucleus. Some operators rapidly introduce a large scoop into the vitreous chamber, behind the cataract, and withdraw the cataract with, or without the capsule. Others remove the speculum, close to the lids, and leave the cataract until the incision has healed, and the parts have returned to their natural positions. The latter proceeding is preferable if the vitreous escapes before the capsule has been opened. If it escapes during the after removal of the nucleus, no attempts should be made to remove particles of cataract that may be lodged behind the iris. These particles which are visible should be left, if soft; if hard, they should be removed with the scoop, syringe, or forceps.

The escape of vitreous is frequently followed by more or less inflammation; and sometimes by suppuration of the eyeball. From six to eight leeches should be applied to the temple of the eye operated upon, the evening after the operation. Pieces of lint, dipped into warm water, are applied frequently to the closed lids of both eyes, and atropia is made use of, as in severe iritis.

Depression of Cataract.—Reclination, Couching.—The object of the operation is to displace the lens into the vitreous chamber away from the area of the pupil. In half the number of cases operated on in this manner the result has been favorable. While, where the cataract has been removed from the eye, out of 100 eyes, certainly, 85 have obtained useful vision, while only three per cent have lost vision completely.

Vision often begins to fail in from three months to three to four years after the operation, if it is not lost at once by inflammation.

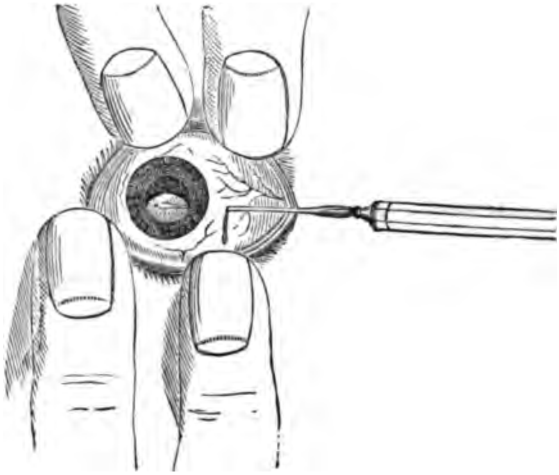
Causes of failure of the operation are:—

(1.) The cataract rising again, having only in part become absorbed, or not at all.

(2.) Inflammation round the non-depressed portions.

(3.) The displaced cataract acting as a foreign body (this is the most common cause of failure), and giving rise to glaucoma, or to exudation upon the ciliary processes, with displacement of the adjoining retina.

Operation.—The patient and the operator are placed as for



(Fig. 31.)

extraction; the pupil being dilated by atropia, the eyelids are kept open by the wire-speculum, and the eyeball is "fixed" with the forceps. A "couching needle" is thrust through the sclerotic near the lower and outer margin of the cornea, as is shown in Fig. 31. It is pushed on behind the iris until its point appears in the area of the pupil. The broad surface of the needle is then placed upon the cataract, a little above its anterior pole. By steady pressure backwards and downwards the cataract is displaced into the vitreous chamber. It should not come in contact with the retina or with the ciliary processes. It should rest in the vitreous chamber, with its anterior surface directed upwards. As much as possible of the capsule should be depressed with the cataract. Some, at first, break up the vitreous to "prepare a bed for the cataract." Soft portions of cataract, which may have remained behind the pupil, are left undisturbed. It suffices to have depressed the hard nucleus.

Accidents.—The needle, if it becomes entangled in the nucleus of the cataract, has to be withdrawn and reintroduced in a better direction.

The consistence of the vitreous substance may impede the displacement of the cataract. In this case, we continue pressing in the proper direction until the cataract has disappeared from behind the pupil. If the cataract has been displaced into the anterior chamber, and we do not succeed readily in pushing it back through the pupil, it must be moved through an incision in the cornea. The cataract has to be extracted if it should rise again. An iridectomy with extraction of the displaced cataract from the vitreous chamber is the last resource if glaucomatous changes appear.

Removal of Cataract by Absorption (*Solution*, *Discussion*, *Keratonixis*).—This mode of treatment takes advantage of the power which the "eye" possesses to abstract the cataract when brought in immediate contact with aqueous humor.

The operation is indicated—(1.) In persons below the age of fifteen.

(2.) In soft cataract, especially with broad opaque striæ, if the pupil responds well to atropia.

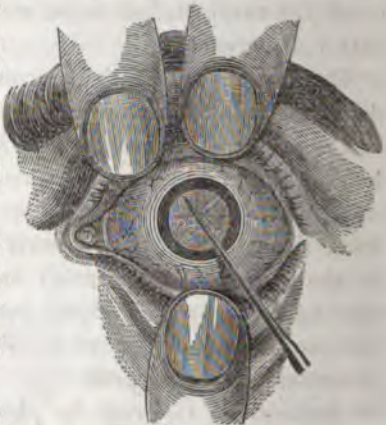
(3.) In persons of all ages, if the nucleus of the lens is not too hard, only one eye is affected, and slowness of recovery of no consequence.

Linear or scoop extraction may have to follow the operation if it is desirable to hasten the removal of the cataract; or if, through iritis, the capsule has become thickened, or the pupil closed.

The operation should be combined with iridectomy—(1.) If much of the lens is transparent, or if the cataract has the consistence of the healthy lens. In both cases much swelling of the lens must be expected. (2.) If the centre of the lens is hard. (3.) If the pupil is small, and but little influenced by atropia. (4.) If glaucomatous symptoms appear.

The Operation.—Restless patients are placed under chloroform. In all cases the eyelids are kept open by the wire-speculum, and the eyeball is fixed by forceps.

A "cataract needle" is thrust through the cornea (about one-eighth of an inch from its margin), as is shown in Fig. 32, into the anterior chamber, and pushed on until its point has passed a little beyond the middle of the previously dilated pupil.



(Fig. 32.)

The point of the needle is at that point thrust through the capsule. No resistance, or hardly any, is felt when doing this.

A well-dilated pupil is a favorable symptom, since complications are less likely to arise from the contact of particles of cataract with the iris.

The manipulations with the needle can be carried out with much greater precision when using lateral illumination. The object of these manipulations is to make several incisions into the cataract. The incisions should converge towards, and pass into, the first puncture of the capsule. By these incisions the capsule is freely opened round the anterior pole of the lens.

After having made the first incision, we withdraw the point of the needle from the cataract, carry it over the surface of the capsule to a point situated more eccentrically; thrust it again through the capsule, and carry this incision into the first one. In this way, from four to six incisions are made to converg into the first one.

The entire anterior surface of the capsule and of the cataract may be broken up at once if the iridectomy has been performed before the needle operation.

Large incisions should also be made if iritis has preceded the cataract, since the capsule is often thickened, or has lost its elasticity. The more the capsule is lacerated the better is the cataract exposed to the contact of the aqueous humor, and the more complete is its absorption. Capsular obstructions are also less likely to occur. Free laceration of capsule, however, is accompanied by considerable swelling of the cataract. Contact of the cataract with the iris and ciliary processes is, in many cases, the cause of unfavorable complications. It is therefore safer, by the first needle operation, only to break up the capsule and lens at and near the anterior pole, and not to carry the incisions too deep.

In children, the entire lens is often broken up at once, and with impunity, though, in these also, it is safer to proceed as indicated above. In older persons, even, small particles of cataract, when coming in contact with the iris or ciliary processes, may give rise to severe inflammation.

The incisions into the capsule, as a rule, become enlarged spontaneously through swelling of the cataract. A few days after the operation we find gray and opaque flocculi projecting from the wound in the capsule. The centre (nucleus) of the lens, or some segment of it, occasionally falls into the anterior chamber. Hard nuclei swell out but little, and become absorbed very slowly: if they give rise to iritis they should be removed by extraction.

The time necessary for absorption varies from four weeks to nine months. The softer the cataract, the remainder of the eye being sound, the quicker is the absorption.

The more glutinous or transparent the lens the more swelling may be expected when it becomes opaque.

Accidents during the Operation and after Treatment.—(1.) The aqueous humor may escape before the needle has reached the cataract; in which case the pupil becomes contracted. This happens if the needle is not well made, or if the patient suddenly moves the eye, so as to cause the needle to escape from the aqueous chamber. In this case we break up the surface of the cataract, which lies in the area of the contracted pupil; being careful neither to stretch nor to scrape the iris.

(2.) Puncture of the iris with the needle is of no consequence.

(3.) The capsule of the cataract may be so tough that we are unable to tear it readily with the needle. In this case an incision should be made through the cornea, and the capsule extracted with the sharp hook.

(4.) Breaking through the hyaloid fossa with the needle. This allows the vitreous to advance into the pupil. The latter suddenly becomes clear.

This accident is followed by more or less inflammation, and requires the treatment which would be adopted for severe iritis.

The absorption may be arrested—(1.) Through the wound in the capsule being too small, or becoming closed by transparent, newly-formed substance. Absorption is progressing as long as opaque flocculi can be perceived in the pupil. A second needle operation becomes necessary only when the area of the pupil has assumed an uniformly smooth and opaque appearance.

(2.) Through iritis. This is by far the most common cause. Iridectomy with extraction through a small opening in the cornea should be performed after the iritis has completely subsided under treatment.

During absorption, only slightly increased vascularity, with some watering, and intolerance of light, should appear. The pupil should be well dilated by atropia; and the eye operated upon kept bound up until all intolerance of light has ceased.

Suppurative iritis or choroiditis, or even ophthalmitis, may occur. Slight iritis, leading to posterior synechiæ, is quite the rule, however carefully the after-treatment may have been conducted.

The usual cause of inflammation, especially of iritis, must be sought in the irritation produced by portions of cataract coming in contact with the iris or ciliary processes. The tendency to inflammation varies much. In one case, suppuration of the iris may follow after one carefully-performed needle operation; in another case, as many as twenty needle operations, each followed by some iritis, may result in useful vision.

The patient, after the operation, is kept in bed for 36 hours; and lint, moistened with cold water, is applied frequently to the closed eyelids, especially in the evening. Atropia is applied to both eyes three times daily. The eye operated upon is kept closed; and a shade is worn over both eyes *until all intolerance of light has ceased.*

One needle operation may suffice to induce complete absorption of the cataract. By some, as many as twenty have been deemed necessary on one eye.

Iritis may set in a few days after the operation, or six, or eight weeks later, or as long as larger portions of the cataract are left for absorption. We, therefore, should keep sight of our patient, and, at once, adopt the treatment of iritis if severe pain is complained of over the eyebrow and in the temple of the eye operated upon, with watering and intolerance of light.

Most of the complications arising from iritis are avoided by a timely iridectomy and by the frequent use of atropia.

Spectacles may be given for near work as soon as the area behind the pupil has become clear, and all intolerance of light has ceased. Frequently no spectacles need be worn for going about.

REMOVAL OF CATARACT BY LINEAR EXTRACTION.

The operation is indicated—

In cataract with a hard nucleus, *i.e.*, as a rule in cataract occurring in persons below forty.

The object of the operation is to remove the soft cataract,—whether rendered soft by nature or by art,—through a small incision in the cornea. Many perform iridectomy immediately, or several weeks previous to the linear extraction.

Operation.—The patient, if quiet, need not take chloroform. A lancet-shaped knife is thrust through the cornea (at about $\frac{1}{10}$ in. from its outer and upper margin) into the anterior chamber, and an incision about $\frac{1}{8}$ in. in width is made. While slowly withdrawing the knife the aqueous humor, and generally some of the cataract, escapes through the incision, if the capsule of the lens has also been incised while making the corneal incision. Gentle pressure upon the eyeball, with the forceps, which fixes it, or friction of the closed eyelids against the eye, assists in removing the rest of the cataract. Portions which do not readily escape by these means should be removed by suction.

Particles of chalk mixed up with lens matter, when left in the anterior chamber, may set up iritis. They should be removed with the scoop, forceps, or syringe.

If the capsule has not been opened previous to, nor while making the incision into the cornea, this should be done with the pricker as in extraction, or better, with the sharp hook after completing the incision. The capsule should, if possible, be withdrawn with the iris forceps, or with the sharp hook. This may be done either before or after the removal of the opaque lens matter, care being taken not to encourage the escape of vitreous substance.

Accidents during the Operation.—(1.) The consistence of the cataract may have been mistaken, and none, or only a small quantity, may have escaped by the means indicated above. In this case, no force must be used to remove the cataract, but iridectomy, upwards, should be performed. The eye must be watched carefully, and treated as after extraction, the rest of the cataract being left to become absorbed, or to be removed a week or fortnight later, after it has become more fluid.

(2.) Prolapse of the iris, or anterior synechiæ. This accident and its complications are avoided by iridectomy. The protruding iris is removed with forceps and scissors, if friction of the eye with the eyelid does not cause it to recede. The same proceeding is adopted if the prolapse occurs some time after the operation, and if it does not subside on the application of Calabar.

Most accidents arising from the iris are avoided by iridectomy performed at the time of, or previous to, the extraction.

(3.) Spontaneous bleeding from the iris. The blood, if it does not escape readily by the use of the scoop or syringe, must be left to be absorbed.

(4.) The vitreous substance may advance into or through the pupil (the occurrence of this accident is characterized by the area of the pupil suddenly becoming "black"); or the "vitreous" may even escape through the incision. It always displaces particles of cataract behind the iris. Attempts to remove small particles are useless. The termination of these cases is more favorable if iridectomy has been combined with the extraction.

Severe pain in the eye and corresponding side of the forehead, and even attacks of vomiting, often follow. Iritis frequently appears about the third or fourth day after the accident. Sometimes it is followed by suppuration of the iris and cornea, or by ophthalmitis.

In rare cases the pupil (with its margin pushed back) remains irregularly dilated, but clear. The margin of the pupil probably becomes adherent to the vitreous substance. This state, with a good anterior chamber, with slight intolerance of light, and with some increase of tension, continues in some cases for six or eight months. In the majority of cases, the vitreous substance after from 12 to 24 hours (during which the pain continues more or less) recedes behind the pupil. The patient must remain in bed; and ice, or application of cold water, must be used very frequently to the closed eyelids of both eyes, together with atropia every second hour, during the day, until the pain has subsided.

MODIFIED LINEAR EXTRACTION.

The indications for this operation are the same as those for flap extraction. But it has also certain special indications:

1. For the removal of cataracts whose cortical portion is quite adherent, and whose capsules are of normal consistency.
2. Where general or local conditions render suppuration at the cornea imminent.
3. Where the condition of the patient renders a less strict regimen advisable, or, more particularly, a shortening of the time of confinement to bed.

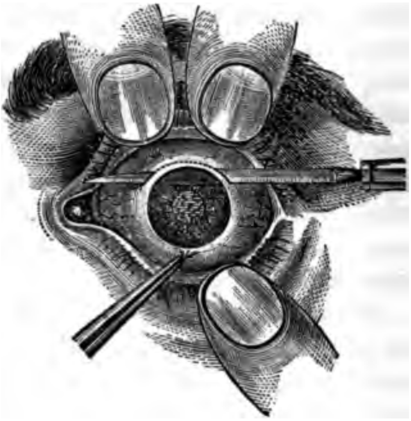
The operation is much like flap extraction, and, like this, is done with several pauses, for the patient to rest and recover himself.

The instruments required are a narrow, pointed knife (Græfe), iris forceps, and a fine Louis' scissors; a delicate sickle-shaped needle, with rounded, blunt back; a sharp and a blunt hook; a thin and very flat spoon (Bowman's), or better, a scoop with projecting anterior edge (Critchett), a toothed forceps and a spring speculum.

The sickle-shaped needle and the hook should have mallable necks, so that we may alter the curvature; for if the neck of the instrument is straight and stiff, and the eye is deeply set, the instrument cannot be readily introduced flat into the wound and moved in various directions in the plane of the iris. For the same reason, the spoon is more convenient, if its concavity is at an angle to the neck.

Snowden's spring speculum, which has long been in use, does not answer well here, because the part uniting the two arms interferes with the introduction of the different instruments. Hence this part has been much elongated, so that, when in use, it rests on the temporal region (Græfe). But the elongation of the arms causes a loss of power in the spring; hence the instrument must be made heavier, or furnished with an adjusting screw, which is somewhat objectionable.

It would seem best, therefore, to have a small Snowden's speculum, with an anterior curve, so made that the part uniting the arms should lie on the side of the nose, when the instrument is placed in the conjunctival sac.



(Fig. 33.)

In modified linear extraction, the *upper* part of the anterior scleral zone is usually opened. In order to make the requisite linear section at this place with one, or a few strokes of the knife, the upper eyelid should be held well back by the operator or assistant; and, to prevent the rolling of the globe, this is seized with toothed forceps, placed exactly under the lowest point of the corneal margin, downward, and held in this position. (Fig. 33.)

The incision should vary in length according to the supposed size of the nucleus; but four, to four and a-half lines, may be considered as the medium length.

For this purpose the knife should be entered about one-third to half a line from the anterior margin of the cornea, and two-thirds of a line to a line below a tangent to the highest point of the cornea, in the outer part of the anterior scleral zone.

The knife is to be held with the cutting-edge inward and upward, and its point directed towards the middle point of the anterior chamber. It is entered obliquely in this position, so that it appears in the anterior chamber, close to the origin of the iris; it is advanced about three lines, and then turned horizontally, so as to be passed through the corresponding inner portion of the anterior scleral zone, at the same height, and at an equal distance from the cornea as the point of entrance. When this has been done, the instrument should be passed on horizontally, with its back downwards, and anteriorly (Fig. 33.); and if the point comes near the nose it should be drawn back till its edge has severed the attachment of the upper section of the iris, as far as the margin of Descemet's membrane, and rests against the inner wall of the sclera. Now the knife should be turned so that its back shall be towards the ideal centre of the corneal curvature, so that the capsule of the globe may be divided by long strokes almost perpendicularly to its surface. Then the knife lies between the sclera and conjunctiva, and the latter appears raised in a broad fold. As the conjunctiva is very distensible and gives way, the cutting-edge should be turned forward, and the membrane divided by a sawing motion. The wound in the latter thus forms an anterior convex arc, whose summit reaches nearly to the limbus conjunctivalis.

The second step of the operation, the excision of the portion of iris presenting at the wound, is facilitated by the use of the spring speculum. In order to manipulate readily, it is necessary to lay the conjunctival flap back on the cornea. The piece of iris is then seized with the forceps, pulled out and cut off close to the scleral wound, so that no tags may remain in the wound.

The speculum may now be dispensed with, and had better be removed. The opening of the capsule requires a sickle-shaped needle, whose neck is suitably curved. This is passed flat through the wound to the lower part of the pupillary border. Its edge is then turned towards the capsule, which is to be divided by several incisions, crossing each other as far as the upper margin of the lens. It is also well, if possible, to pass the needle around the margin of the lens, so as to make the capsular opening large.

If the capsule has been sufficiently divided, the lens often appears at the scleral opening, and but little assistance is required for its escape. For this purpose, it is well to draw on the fixation forceps a little, so as to render tense the lower part of the capsule of the globe, and, at the same time, with the back of the spoon, to make pressure on the posterior lip of the scleral wound. If this does not accomplish the object, we should try the sliding manœuvre, *i.e.*, while the finger fixing the upper lid makes slight pressure on the upper part of the eyeball, the back of the spoon is gently pressed against the lower border of the cornea, and towards its centre.

In most cases, this manipulation brings the lens into the scleral wound, and so far through it, that it may be seized with the hook or spoon, and drawn out. We may especially count on this, when the cortical layers are wholly disintegrated, and the nucleus is loose in the capsule. But if the cataract does not come out, we should use the so-called traction instruments, as they are certainly less dangerous than continued pressure on the globe, which, moreover, does not attain the desired end. If we have to deal with a large sclerosed nucleus, we should use a blunt hook, which, like the sickle-shaped needle with a bent neck, should be passed flat through the wound, and the posterior cortical layers of the cataract, to a point beyond the equator of the nucleus; then the point should be turned forward, the lens seized and drawn out. This usually succeeds readily, even if the upper margin of the capsule has not been sufficiently divided, for the latter is easily everted by the escaping cataract. In cataracts with normally consistent nucleus, however, the hook readily cuts through, breaks up the lens, and leaves the fragments behind, as they readily avoid it. In such cases, as well as where a normally consistent cortex must be separated, a suitable spoon should be substituted for the hook.

Any of the soft, broken lens mass that still remains in the capsule may, as in flap extraction, be pressed towards the opening by stroking the cornea with the back of a spoon. If the remaining portions are not completely evacuated, there is nothing left but to pass a spoon into the wound and scoop them out.

Just as in flap extraction, we should make it a rule to clear out the cataractous lens as completely as possible; to draw out portions of capsule that have become stiff from deposits; clean the wound properly, and remove any pieces of iris that may be caught in it; and, finally, to replace the conjunctival flap in its natural position. When all this has been done, it seems advisable to open the eyes again in a minute or so, and let out aqueous that has collected; for this not unfrequently washes out with it some small pieces of cataract and effused blood.

The after-treatment and dressing are to be regulated as in flap extraction. But in modified linear extraction, after the first couple of days, the patient requires less restriction, and may be allowed more freedom, as the detachment of the flap is here less to be feared. After the second day, instillations of solution of atropine should be made with proper care, once or twice daily, so as to diminish, as much as possible, the irritating influence of any retained portions of cataract.

CAPSULAR OBSTRUCTIONS.

(*"Capsular Opacities;" "Opaque Capsule;"*) *False Membrane; Opacities behind the Pupil.*

We distinguish the following capsular obstructions:—

(1.) Those which precede the removal of cataract; and (2.) Those which follow the operation.

Changes accompanied by inflammation near the surfaces of the capsule give rise to opaque spots upon those surfaces; *e.g.*, if, during purulent ophthalmia, the lens and its capsule come into contact with the swollen suppurating cornea (whether perforation occurs or not), opaque dots upon the surface of the capsule may follow.

The anterior polar or pyramidal cataract, situated on the outer surface of the anterior capsule, and projecting through the pupil, is of this origin. Ulceration of the cornea, wounds of the capsule, iritis, eyelids, etc., may give rise to opaque spots, which, as dissection shows, are due to an alteration in shape and transparency of the intro-capsular cells. These, instead of developing into lens fibres, grow out into differently-shaped cells. Particles of chalk and spicules of bone have been found in such opaque spots.

On the outer surface of the anterior capsule, and in its substance, have been found globules of a yellowish, translucent, finely-granular substance in appearance, and, chemically, resembling that of the capsule itself.

Opaque, warty, globular "excrescences," and deposits of lime in grains, globules, etc., if considerable, appear to the naked eye as radiating or irregular white, or gray and opaque, streaks or dots. Posterior synechiæ, corneal opacities, and other signs of past inflammation, often occur simultaneously. Spots of brown or black pigment, or vascular or non-vascular opacities, derived from the iris (with or without synechiæ), are common complications of capsular opacities.

The opacities just described may be present with or without any other alteration in transparency of the lens; or may remain after the lens, or part of it, has been removed.

The opacities observed after the removal of cataract are chiefly caused by "opaque lens matter," which has not been removed; or has not become absorbed; or being transparent at the time of operation, has subsequently become opaque.

If the anterior capsule is freely opened, and the entire lens removed, and no inflammation follows, no opacities occur behind the pupil. The anterior capsule retracts towards the suspensory ligament, and the transparent posterior capsule is slightly bulged forwards. This favorable result, unless the anterior capsule be entirely removed, is hardly ever obtained, however good vision be. We mostly find, on dilating the pupil, an opaque white rim of varying width near the tips of the ciliary processes. This rim consists of debris of cataract, enclosed within the capsule. It need not be disturbed as long as the area of the pupil is clear, and the transparency and smoothness of the posterior capsule are not altered.

Opaque deposits upon the surface of the capsule occur whenever inflammation (iritis, eyclitis, etc.), however slight, follow the operation for cataract. They retard or prevent the absorption of opaque lens matter, render the capsule stiff, and are the means of adhesion between it and the adjoining iris.

Minute examination of sections of "opaque capsule," the result of one or of several of the above causes, shows that in all instances the capsule can be traced as a transparent line across the opaque substance. When using the term "opaque capsule" in these, we do not mean an opacity of the capsule itself, but a deposit of opaque lens matter, of chalk-granules, of connective tissue, etc., upon the surfaces of the transparent capsule.

Treatment.—The removal of capsular obstructions, especially if performed roughly, is not without danger. Eyes with useful vision have been lost in consequence of glaucomatous changes, or suppuration, or intraocular hemorrhage, or displaced retina, or severe iritis, with closure of pupil.

Among the accidents which may give rise to these unfavorable results are—separation (by the instrument used for the operation) of the suspensory ligament and of the adjoining retina from the choroid;—laceration of the ciliary processes, and hemorrhage into the vitreous chamber; laceration of the vitreous substance, causing the latter to advance through the pupil into the anterior chamber. The latter accident is sometimes complicated with hemorrhage between the choroid and sclerotic, and glaucomatous symptoms ensue.

We should leave the capsular obstruction undisturbed as long as the capsule and the opacities attached to it do not prevent vision, *i.e.*, as long as the patient can read ordinary type. The removal of such obstructions, whether opaque or transparent, while the eye is irritable, intolerant of light, or inflamed, is often followed by iritis, or by hemorrhage, and by fresh opaque deposit.

The removal of capsular obstructions, which follow depression of cataract, most frequently give rise to severe inflammation.

Those who perform depression advise, unless vision be materially impaired, not to interfere with the obstructions.

It is safest to perform the operation of removing capsular obstructions when the eye is entirely free from all undue vascularity, and when it is of normal tension, and possesses good perception of light in all parts of the retina.

The only obstructions requiring removal are those which lie in the area of the pupil; and only as much need be removed as is equal to the size of a pupil of medium dilation.

The Operation.—The pupil having been dilated as much as possible by atropia, and the patient placed as for extraction of cataract, chloroform is given if the patient is at all inclined to be restless. The lids are kept open with a stop-speculum, and the eyeball is well steadied by the operator before attacking the capsule. An assistant, standing at the side of the patient with a convex lens of from three to four inches focal distance, concentrates the light of a lamp upon the portion of capsule we propose removing. A careful examination of the capsule, of its relation to the parts surrounding it, and of the portions we wish to remove, should immediately precede the operation. All steps which may give rise to bleeding should be avoided; or if unavoidable, should only be taken after removal of the obstruction. Softish eyes, and those in which, after long-continued choroido-iritis, the parts within the eye have lost their elasticity, are most inclined to bleed. The blood, which becomes accumulated in the anterior chamber, in these cases proceeds from vessels of the conjunctiva, or of the iris or capsule; and bleeding is often avoided by making the incision through a transparent part of the cornea. The vitreous substance is least disturbed, while removing capsular obstructions, by moving the instrument, needle, etc., as much as possible in a plane with the portion of capsule which we wish to withdraw.

Folds of transparent capsule should be torn through with one or two needles. Suppose such folds to have a vertical direction, and we propose dividing them with a cutting-needle; we pass the needle through the cornea near to the upper margin, carry the point up to and through the folds near the inner margin of the pupil, and thence horizontally across the folds, dividing them with the cutting part of the needle as far as the outer margin of the pupil. We then, having obtained a transverse clear slit in the folded capsule, withdraw the needle, if possible without passing any aqueous humor.

Opaque filaments, stretched across behind the area of the pupil, may, in the same way, be divided with one or two needles. The divided portions are expected at once, or after some weeks, to shrink away from behind the area of the pupil.

When using two needles, some practice is required to keep the attention fixed on both. Suppose we have not succeeded with one needle in dividing an opaque filament, which, *e.g.*, extends horizontally across the area of the pupil, we then, without withdrawing the first, introduce a second needle. The first needle, having been thrust through the cornea near its upper margin, and the point having been carried a little beyond the opaque filament and in front of it, the second needle is thrust through the cornea near its lower margin, and the point is carried behind and a little beyond the filament. The points of the two needles are then rotated round each other, so as to cause the elastic filament to become twisted once or twice round the stems of the needles. By drawing the points in opposite directions the filament is torn through.

Opaque capsular obstructions which are too large to be cut through with one or two needles, are removed with the sharp hook. To do this, an incision is made through the cornea near its margin, and opposite to the spot where the capsule appears thinnest, or its attachments to the surrounding parts are least thickened, by previous inflammation. The sharp hook is then introduced (in the same manner as a blunt iris hook) up to and through the part of the opaque capsule which lies farthest from the incision in the cornea. The capsule is gently torn away from its attachment, and either drawn out through the incision, or, if too firmly attached near the incision, it is drawn out, as much as possible, and cut off; the rest is pushed back "into the eye."

The opaque capsule need not be removed from the eye if a clear pupil, about the size of a natural one, has been obtained by merely tearing the capsule away from its insertion opposite the incision; and if, at the time of operation, it shows no tendency to return to its former place. If the attachments of the capsule are so firm that considerable force is necessary to tear them with the hook, or if, while attempting to do so, the sclerotic next the hook is drawn in, we take a small, sharp, lancet-shaped knife, and thrust it through the cornea and capsule into the vitreous chamber between the hook and the part of the sclerotic thus drawn in. Then, having cut through the firmly-attached part of the capsule, we quickly withdraw the knife, and having with the other hand held the hook inserted into the capsule, withdraw the latter.

The pupil, though much of the capsule and iris may have been removed, may become closed by blood and fibrine; or may become contracted again, though no hemorrhage has occurred. This happens often in eyes which have suffered from severe choroido-iritis, and in those in which an inflammation, following operation, has not completely subsided. Good vision has been obtained in such cases by counteracting the tendency to contraction by a T-shaped incision through all the parts which separate the anterior (aqueous) from the vitreous chamber. To effect this, we thrust a lancet-shaped knife through the cornea close to its margin, and through the adjoining iris and capsule into the vitreous chamber, then withdraw the knife quickly, and introduce a pair of strong iris scissors through the incision in the cornea. In the anterior chamber we open the scissors, and pass one blade through the incision in the iris and capsule into the vitreous chamber, the other in front of the iris; we next push on both blades until the one in the anterior chamber has nearly reached the opposite margin of the cornea, and then cut through all the parts which lie between the blades.

Most of the above operations are attended with loss, or at least with displacement or disturbance, of some of the vitreous substance. To avoid inflammation and complications arising from sickness, we apply atropia to the eye not operated on, tie wet lint over the closed lids of both eyes, and keep both eyes at rest and the eye operated upon closed, until all intolerance of light and other signs of irritation have ceased.

CONGENITAL CATARACT AND CATARACT IN CHILDREN.

Causes and General Remarks.—In a few instances congenital cataract has been observed in one eye only. Its most frequent cause appears to be inherited syphilis (with or without traces of iritis).

Peculiarities in the shape of the head; in the color, etc., of the incisor teeth, which may be of the notched syphilitic kind, or may present nodular, uneven surfaces, so-called 'rocky teeth,' are observed in most cases. As many as six cases of congenital cataract have occurred in one family.

A frequent cause of cataract in children is purulent ophthalmia. An opaque, white, nodular deposit, at or near the anterior pole, with the lens otherwise transparent, and opacity of the entire lens, if there has been much suppuration of cornea, are the two forms usually observed after purulent ophthalmia.

As complications must be mentioned—posterior synechiæ (following intra-uterine iritis); persistence of portions of the pupillary membrane; atropic changes in choroid and retina; displacement of the retina (particularly if the cataract has appeared rapidly) is large, of the uniform gray and opaque kind, with chalky deposits on its surface, or if it appears as what is termed posterior polar cataract; opacities of the cornea (following intra-uterine corneitis, or purulent ophthalmia); nystagmus (which generally appears soon after birth), if there be cataract in both eyes; coloboma, arrest of the development of the entire eyeball; absence of the iris; conical cornea; myopia. The latter is a frequent complication.

Symptoms and Course.—The cataract, if well marked, is readily noticed by the parents soon after birth. When slight it is often overlooked. Patients may pass through life without its having been noticed, until it may have become complicated with senile cataract. Nystagmus, smallness of the eyeballs, or some peculiarity in the movements of the eyes when objects are grasped, may attract the attention. If the cataract has been overlooked at first, it generally becomes noticed when the child begins to read; objects are held close to the eyes, or in a peculiar position.

The characteristic symptoms are opacities, varying in kind and extent, in and upon different parts of the crystalline lens and its capsule. The lens should be examined with artificial light, the pupil being dilated with atropia.

Numerous varieties arise from the varying forms and positions of the opacities. The most frequent are:—

(1.) A minute dot of chalky whiteness, situated in the middle of the clear pupil. The dot may have a conical shape projecting into the anterior chamber; or it may occupy the entire area of the pupil, the rest of the lens being transparent or slightly opaque; small white dots may be found round the central one.

A similar white, opaque, and circular dot is occasionally met with at the posterior pole of the lens.

(2.) Irregularly-shaped or circular faint gray and opaque or buff-colored spots, of different sizes, which are sometimes extremely minute, very numerous, and sprinkled over the anterior surface of the lens (this form is often overlooked).

(3.) A ring-shaped, faint gray opacity at the posterior pole of the lens, with opaque striæ radiating from it.

(4.) An irregularly-shaped, small, opaque, and white substance occupying the place of the lens.

(5.) A uniformly gray and opaque lens, or a semi-opaque nucleus, with a transparent cortical substance.

The lens is generally smaller, and not unfrequently irregular in shape: the distance of its margin from the ciliary processes varies. Transparent portions of lens may intervene between opaque ones (so-called lamellar cataract). The cataract, especially if of long standing, may be fluid (a thin layer of chalky white and opaque fluid enclosed within a tough capsule). Even in children (especially if iritis has preceded) a hard nucleus may be found.

The opaque white dots which are often seen in the area of the pupil are attached to that portion of the surface of the capsule which lies next the lens. They project through the pupil into the anterior chamber, and when touched with the needle often break off. In infants they generally appear gray and opaque. They gradually become whiter.

Treatment.—Any treatment tending to improve vision, or operations for the removal of cataract, should be adopted as early as possible. The sooner an operation is performed the quicker is the recovery, and the better the result as regards vision, movements of the eyeballs, etc. Cases of congenital cataract without perception of light, unless for reasons of personal appearance, should not be operated upon. The removal of cataract from one eye, the fellow-eye being sound, does not interfere with the functions of the sound eye. If there be perception of light, however slight, and even if the shape of the eyeball be below par, the cataract should be removed. Improved vision and nutrition of the eye operated upon will result.

Patients with an opacity confined to a circumscribed portion, *e.g.*, the anterior pole of the lens, can with advantage, for years, make use of atropia. An iridectomy, without removing the cataract, may be recommended if the margin of the lens be transparent (which may be ascertained with the ophthalmoscope), the opacity well-defined, and no increase of impaired vision complained of. By this treatment the accommodation of the eye is preserved, and the use of spectacles rendered unnecessary for years.

If neither the use of atropia nor an artificial pupil procures useful vision, we remove the cataract, either by absorption, which is the slower and safer mode, or by linear extraction, or by suction. Children bear these operations well. The greater part of the cataract may, after opening its capsule, come to be in the anterior chamber; and may become absorbed without setting up much irritation, while the same accident in a grown-up person may lead to ophthalmitis.

Cases in which the bulk of the lens is transparent, and only the surface or some of the layers of the lens opaque, are more troublesome; more irritation accompanies absorption. When removing the irregular white and opaque substance, which in some cases occupies the place of the lens, we must be very careful not to use any force. If the substance should not readily follow traction with the forceps or sharp hook, it must either be left, or must be separated from adhesion, especially on the side next the vitreous chamber, by passing a small, lancet-shaped knife behind it.

DISLOCATION OF THE CRYSTALLINE LENS.

("*Ectopia of the Lens.*")

(1.) *Dislocation of the Lens into the Anterior Chamber.*—The presence of the transparent lens into the anterior aqueous chamber betrays itself by a yellowish, shining, circular line (the margin of the lens), which, on looking sideways into the chamber, may be seen near the margin of the cornea. A similar appearance, though not so well-marked, has, in one case, been caused by "vitreous" filling the chamber. The iris is pushed backwards; the pupil sluggish, or fixed, and somewhat dilated. The optic disk, viewed with the ophthalmoscope through the dislocated lens, appears unusually small.

The lens in this situation may remain transparent for years (in one case twenty years). It appears larger in its antero-posterior, and smaller in its lateral diameter; it gradually becomes yellowish. Attacks of iritis frequently follow, and the lens becomes adherent to the anterior surface of the iris. The posterior surface then loses its transparency, thus hiding the iris, the pupil, etc. After having undergone adhesion, the lens becomes smaller, and shrinks towards its adherent portion; while the pupil and the remainder of the iris become visible and tremulous. The dislocated lens may also become adherent to the posterior surface of the cornea, and cause ulceration and perforation, which proceed from within outwards. The lens may become opaque and be absorbed, or it may change into a small, chalky-white, hard substance. The latter sometimes rolls about freely, and passes from the anterior through the pupil into the posterior chamber. This substance may become adherent somewhere. Attacks of iritis, when once they appear, often recur.

The lens may be dislocated so as to stand sideways in the pupil, part of it projecting into the anterior chamber, where the peculiar golden reflection from its margin may be seen.

(2.) *Dislocation of the Lens into Vitreous Chamber.*—A clear, sluggish pupil, and a deep anterior chamber with tremulous iris, together with the history of the case, may lead us to suspect this dislocation.

The lens is generally visible to the unaided eye, and always when sought for with the ophthalmoscope. The observer should look with the ophthalmoscope as much as possible behind the lower posterior surface of the iris, while the patient directs the eye downwards. The dislocated lens, which may be transparent, or grayish and opalescent, or chalky-white, is readily perceived as a disk-shaped substance which floats behind the iris in the vitreous chamber. The entire lens is seldom visible; the well-defined opalescent margin farthest distant from the iris generally comes into view.

Sometimes the suspensory ligament is elongated, or only a portion of it is ruptured, and the lens is seen swinging to and fro behind the pupil. Cases have occurred in which the patient has had the power of displacing the lens through the pupil into the anterior chamber, and back again behind the iris.

The lens may be displaced directly backwards, together with the suspensory ligament, the latter having for some distance been stripped of the ciliary processes; or the lens, enclosed in its capsule, may have become detached from the hyaloid fossa, and fallen into the posterior chamber. In a case of this kind extraction of the lens has been performed with good result.

(3.) *Lateral or Oblique Dislocation of the Lens.*—The lens, in some cases, is found displaced towards the ciliary processes; in others, one margin is tilted forwards towards the iris, while the opposite margin recedes towards the vitreous chamber. Part of the iris is pushed forwards; part of it recedes, as may be seen from the unequal depth of different portions of the anterior chamber. The iris is not always tremulous. Dislocation inwards and upwards is the most frequent form. The lateral displacement may be so considerable that only one-third of the pupillary area is occupied by the lens; and when looking at the optic disk with the ophthalmoscope two optic disks are visible, one indistinctly, the other distinctly. When examining the everted image, we have to change the distance of the convex lens from the patient's eye, according to whether we view the optic disk through the patient's lens, or through the part of the pupillary area free from it.

If the dislocated lens leaves part of the pupil free, images of different degrees of distinctness are formed upon the retina, and diplopia or polyopia is complained of in the affected eye. Much light is reflected, and interferes with the distinctness of vision. Symptoms of astigmatism arise. A convex lens improves vision when held opposite the part of the pupil from which the crystalline lens is displaced.

The oblique position of the lens (one margin receding towards the vitreous chamber) can be recognized by the reflex images from its surface not standing opposite each other when the eye is directed straight forwards. The oblique position may be considerable without much lateral displacement.

Vision, in dislocation of the lens into the anterior chamber, is improved by concave lenses. Convex lenses should be tried when the crystalline lens has in part or entirely disappeared from the pupillary area. Patients with the lens swinging to and fro behind the pupil complain of objects moving, of an appearance as if flowing water were obscuring the object looked at, etc.

When once the absence of the lens from a part of or from the entire pupillary area, and the nature of the dislocation, have been ascertained, we must, in our further examination, be guided by the general rules in use in anomalies of refraction, accommodation, etc.

Every dislocation of the lens is complicated with more or less rupture of its suspensory ligament, and, consequently, with a less, or a great, impairment of the faculty of having the curvature of its surfaces changed during accommodation.

(4.) *Dislocation of the Lens beneath the Conjunctiva.*—The lens, if it has escaped through a rent in the tunics (which rent is generally found close to the upper margin of the cornea), may have done so completely; or its nucleus may have remained while the cortical substance has escaped; or the entire lens and capsule may have become lodged beneath the conjunctiva.

The conjunctiva may appear vascular, or may remain transparent; in the latter case, the displaced lens can be seen as a transparent or opaque, disk-shaped, little tumor, sometimes hiding the rent in the coats of the eyeball. The iris is not always tremulous; frequently a portion of it is drawn into the rent, the pupil being distorted or displaced towards it. For two or three months the lens may remain beneath the conjunctiva, and give no trouble; or it may become opaque and absorbed, leaving the capsule sprinkled with particles of chalk.

Causes.—Most of the above forms of dislocation may be produced by injury (frequently by a blow upon the lower part of the eyeball). Looseness or rupture of the suspensory ligament, or changes in the consistence of the "vitreous," favor dislocation by injury. Dislocation occurs often spontaneously in both eyes; and sometimes in several generations, or in several members of one family. It is often congenital. Most frequently it becomes troublesome after middle age. A fluid condition of the "vitreous," shrinking of the lens itself, a looseness of the suspensory ligament, a general enlargement of the eyeball, may give rise to, without any other changes being visible in the tunics of the eyeball. Myopia is not an unfrequent complication.

The shape of a dislocated lens is often altered; it is indentated or flattened in some part of its margin.

Complications.—Among the complications arising from injury, the most frequent are:—rupture of the tunics of the eyeball,—laceration of the iris,—hemorrhage into the interior of the eyeball,—escape of vitreous,—displacement of the retina. The complications to which the displaced lens gives rise are iritis, choroiditis, and glaucoma.

The lens sometimes undergoes adhesion to the iris, hyaloid membrane, etc., during an attack of inflammation, after which all further disturbance may cease. Attacks of inflammation are often accompanied by great pain. Sudden attacks of pain may occur (the lens being displaced into the vitreous chamber) during certain positions of the patient, *e.g.*, during the recumbent position.

Glaucomatous symptoms frequently appear, whether the dislocated lens be fixed or moved about, whether the eye suffer from inflammatory attacks or not. Sympathetic affections of the fellow-eye are not unfrequent.

Treatment—the Lens being Dislocated into the Anterior Chamber.—We need not interfere if the lens is transparent, if the eye is free from irritation, if the fellow-eye does not sympathize, and if vision is such as to allow the patient to follow his occupation.

The lens should be extracted if opaque or chalky, and if the patient is anxious to have it removed, though the eye be blind. The lens ought to be removed (by absorption, by linear extraction, or by suction) if it is opaque and the retina sensitive. If iritis or glaucomatous symptoms should arise, iridectomy is performed, as well as extraction.

These operations, in some cases, have been followed by slow displacement of the retina (in otherwise large myopic eyes), in others by shrinking of the eyeball, in a few by ophthalmitis.

If the lens is dislocated into the vitreous chamber it does not become absorbed, though it be lacerated.

In some cases it has been extracted successfully with the scoop through an incision in the cornea. In a few instances the operation has been followed by shrinking of the eye.

The lens should, if possible, be removed by absorption, combined with iridectomy, if it is *displaced laterally or obliquely*, and if iritis, or sympathetic irritation, or glaucomatous symptoms arise, or if vision is too much impaired. If there be no such complication, and vision is sufficiently good for the occupation of the patient, nothing need be done. If myopia exist, concave lenses may be of use. If the greater part of the pupillary area is free from the lens, convex lenses may be tried. If the lateral dislocation is but slight, an iridectomy on the side towards which the lens is displaced can be recommended; and spectacles are thus rendered unnecessary.

Treatment.—Simple traumatic cataract in persons below middle age may be left for absorption; or may be removed by linear extraction, the pupil being kept well dilated by atropia. In persons above the middle age we remove the cataract by extraction. At all ages, if there is much iritis, or the iris is pressed forwards upon the cornea, or the tension of the eyeball too great, iridectomy is performed, and the cataract, according to its consistence and the age of the patient, removed either by suction or by extraction. The same treatment is adopted if considerable time has elapsed since the injury, and part of the cataract has become absorbed, but absorption from some cause been arrested.

THE AQUEOUS HUMOR AND THE AQUEOUS CHAMBERS, AND THE VITREOUS SUBSTANCE AND THE VITREOUS CHAMBER.

The aqueous humor ("the aqueous") chemically consists of transparent fluid, with trace of salt (chloride of sodium) in solution. Mixed with it we may find albumen (*e.g.*, in cases of iritis); fibrine and blood-corpuscles (from spontaneous rupture of bloodvessels, or from injury); or merely the coloring matter of blood; sugar (in diabetes); bile; or pus (in inflammation of the surrounding tunics).

Hypopyon signifies an accumulation of pus in the aqueous chamber. The pus may come from an abscess of the cornea perforating into the chamber, or from transudation of plastic material from an inflamed cornea, iris, etc. In the purulent fluid we find mucus, pus-cells, granular and fat molecules.

An unusual quantity of aqueous humor, or its complete absence, or the presence of blood or pus occupying its place, has been observed at birth.

The anterior chamber in most persons of advanced age becomes smaller, from decrease of the quantity of aqueous humor.

The bloodvessels of the iris, and especially those of the ciliary processes, are supposed to be the chief source of the aqueous humor. This view is supported by the facts that little aqueous humor is found when most of the vessels of the ciliary processes and of the iris have become obliterated by inflammation, and that, if the pupil appears completely closed and the tissue of the iris tolerably healthy, aqueous fluid is found in the anterior chamber.

In total posterior synechia we may find the iris bulged forwards by accumulation of fluid behind it, or between its uvreal and contractile portions.

An increase in the quantity of aqueous humor is observed after a successful iridectomy, performed for diminution of increased tension of the eyeball.

Escape of aqueous humor, especially if it occurs suddenly, causes contraction of the pupil, with sudden enlargement of the bloodvessels of the choroid and retina. A prolonged escape through a fistula in the cornea may lead to gradual shrinking of the eye.

Twelve hours is supposed to be the time necessary for the secretion of the usual quantity of aqueous humor of a healthy eye. After operations on the iris we often find the anterior chamber filled with aqueous humor half an hour after all has escaped.

Changes in color of the aqueous humor disguise the real color of the iris, *e.g.*, a blue iris appears greenish or yellowish when viewed through even a slight mixture of haematine with aqueous fluid ("yellowish aqueous humor").

Blood in the aqueous humor becomes quickly absorbed (in from twelve to thirty-six hours) if the eye is healthy; while, if under the influence of inflammatory changes, months may pass before all blood has disappeared. The effused blood itself sometimes sets up irritation. Artificial pressure should be applied to hasten the absorption of blood in a diseased eye; while blood effused into the chambers of a healthy eye may be left to itself.

Pus generally disappears rapidly from the anterior chamber. The heavier particles of pus, blood, etc., settle at the most dependent part, and appear along the lower margin of the cornea as a well-defined, crescentic, yellow or dark-red substance. Movements of the head or eye cause this substance to change its position; or, when stirred up, to mix with the fluid in the aqueous chambers.

Particles of cataract, of lymph, of blood, etc., frequently leave spots of pigment, or of earthy salts, upon the walls of the chamber.

A cysticercus, moving about in the aqueous humor, has been removed by paracentesis.

Cilia and particles of glass have remained free in the anterior chamber for ten years without causing irritation.

A case is reported in which vision was lost by bleeding between the choroid and retina; after a leech-bite in the lower half of the cornea. The chambers were filled with blood.

The boundaries of the *anterior aqueous chamber* are: in front, the epithelial covering of the posterior elastic lamina of the cornea; laterally, those portions of that lamina which pass on to the iris; behind, the epithelial covering of the anterior surface of the iris, and the capsule of the crystalline lens as far as it occupies the area of the pupil.

The remainder of the anterior capsule of the lens, together with the anterior surface of the suspensory ligament (part of the canal of Petit), form the posterior boundary of the posterior aqueous chamber; the tips of the ciliary processes, the lateral boundary; and the transparent membrane covering the uvea, the anterior. The pupil is the opening of communication between the anterior and posterior aqueous chambers.

The aqueous humor probably passes between the margin of the pupil and the surface of the capsule of the crystalline lens, from one chamber into the other. The size of the chamber is determined by the position of the crystalline lens, of the iris, and of the posterior surface of the cornea.

In a *deep* anterior chamber (where the distance of the iris from the cornea is unusually great) the margin of the pupil and the insertion of the iris may be in the same plane; while in a *shallow* anterior chamber the pupil lies much in advance of the insertion of the iris.

Adhesions of the pupillary margin may cause an accumulation of aqueous fluid behind the iris, or between its uveal and contractile portion; and by bulging these may give rise to a shallow anterior chamber, with retraction of the margin of the pupil.

A small puncture of the bulging portion causes the fluid to pass into the anterior chamber, and the bulged portion of iris to assume a more normal position. On the other hand (*e.g.*, after extraction of cataract), the margin of the pupil may become adherent to a portion of the capsule of the crystalline lens, and appear pushed back towards the vitreous chamber, thus increasing the depth of the anterior chamber. Changes in the depth of the anterior chamber are observed in chronic glaucoma, presbyopia (diminished depth), inflammatory changes of the choroid and iris during fœtal life or in infancy (increased depth).

THE VITREOUS SUBSTANCE AND THE VITREOUS CHAMBER.

ANATOMICAL AND GENERAL REMARKS.

The vitreous substance (vitreous humor, vitreous body, "vitreous") occupies the vitreous chamber. The "vitreous" slightly exceeds, in consistence and cohesion, that of the white of a hen's egg. It is transparent, and some of its elements possess great elasticity.

Placed on blotting-paper, the watery portion becomes absorbed, and a delicate tissue, consisting of nucleated fibres, remains.

Replaced in water, this tissue swells out again, and resumes almost its former appearance.

Continued pressure, whether from external or from intraocular causes, tumors, etc., rapidly cause the fluid part to disappear. Traces of albumen are found in the healthy vitreous. The vitreous microscopically consists of transparent fluid and of numerous transparent fibres enclosing cells. These cells and fibres are more numerous at and near the surface of the hyaloid membrane, especially where this membrane passes over the ciliary processes. Upon the inner surface of the hyaloid membrane is found a single continuous layer of large cells. Each cell has one large transparent nucleus. These cells are smaller on the portion of the hyaloid membrane which joins the suspensory ligament of the lens.

The "vitreous" is separated from the surrounding tunics by the hyaloid membrane. The outer surface of the latter is slightly adherent to the retina, and more firmly to the part of the optic disk from which the retinal vessels emerge, and to the suspensory ligament.

The suspensory ligament of the lens ("the zonula zinnii" or "the pars ciliaris retinæ," see also *Crystalline Lens—Anatomical Remarks*) is a transparent membrane. Some describe it as a continuation of the retina. It is intimately connected with the retina, covers the ciliary processes, and is placed between these and the hyaloid membrane.

An amorphous portion passes over the posterior surface of the iris, and merges into its elastic lamina; while the fibrous portion, which lies next the hyaloid membrane, leaves the ciliary processes, near their optics, to join the anterior part of the capsule of the lens.

For the method of examining the vitreous, see *Opacities in the Vitreous Chamber.*

Senile Changes.—The transparent cells of the vitreous substance appear less numerous as age advances; while the "opacities," especially those close behind the lens, increase in extent. The central portions of the "vitreous" become more fluid; while the hyaloid membrane becomes thickened, and more so in some parts.

The transparency of the "vitreous" becomes altered. The vitreous assumes a more or less yellowish tint.

OPACITIES IN THE VITREOUS CHAMBER AND MUSCÆ VOLITANTES MOTES.

The nutrition of the vitreous substance is intimately connected with that of the retina and choroid, and we hardly ever fail to discover morbid changes in the vitreous if the adjoining tunics are in a state of inflammation. These changes result in what are generally termed opacities, the loss of transparency being the most striking symptom of morbid alterations of the vitreous substance.

The nucleated fibres and membranes of the healthy vitreous substance become visible under peculiar circumstances, and represent what are termed *muscæ* or *motes.*

Suppuration, and other, especially syphilitic, forms of inflammation, and absorption of the fluid part of the vitreous substance, give rise to *opacities.* Opacities, as a rule, appear round tumors and foreign bodies, wherever in the vitreous chamber these may be seated. The opacities are most numerous *immediately* round the tumors, etc.

Opacities are usual complications of inflammation of the choroid, especially of the ciliary processes. They appear as yellowish and opaque floating membranes, etc., if the choroiditis be of a suppurative character; gray and opaque if it be more of the plastic kind. They are readily seen by the observer, but not by the patient, to whom they produce the sensation of a mist intervening between the eye and objects.

Hemorrhage into the vitreous chamber, foreign bodies in it, entozoa, tumors, distension of the vitreous chamber during staphylomatous changes, and the different forms of retinitis, are other causes of opacities. Vision is impaired according to the density, size, and situation of the opacities.

Those near the retina throw a shadow, and more or less intercept the light. Such, as regards shape, are accurately described by the patient if the retina is sensitive.

Opacities close behind the lens and in the middle part of the vitreous chamber give rise to general "mistiness" of vision, and to absorption of some, and to diffusion of much, of the light which passes through the vitreous chamber.

During reading the opacities may intervene between the retina and the letters looked at. The patients, by rapid movement, of the eyes, cause the opacities to move away from opposite the parts of retina used in reading. The repetition of this movement finally becomes a habit frequently met with in persons suffering from opacities.

The mobility of the opacities is the greater the nearer they are to the middle of the vitreous chamber; the density and number are the greater the nearer they are to the hyaloid membrane.

Opacities of great mobility are less dangerous to nutrition of the eye, and to the functions of the retina, than those of a more fixed character.

The latter, while shrinking, may lead to displacement of the retina, or to alteration in shape, or even to shrinking of the eyeball.

The movable ones, though they rarely disappear completely, often become less perceptible under treatment.

Treatment of Opacities.—See treatment of hemorrhage into the vitreous chamber; of suppuration of the vitreous substance; of choroiditis. The different forms of choroiditis are frequently complicated by inflammatory changes in the vitreous substance of a similar character to those in the choroid.

An injury of the vitreous substance may be followed by suppuration (see *Pus in the Vitreous Chamber and Ophthalmitis*), or by an escape of blood into the vitreous chamber (see *Hemorrhage into the Vitreous Chamber*). It is generally complicated with injury of adjoining tunics (see *Traumatic Cataract and Injuries of the Tunics*).

Incisions into the vitreous substance, such as are made when operating upon displaced retina,—when tearing up opacities in the vitreous chamber,—when removing portions of that substance protruding from wounds,—or by accidental wounds, are rarely followed by formation of pus, or by inflammation, provided they are made with clean instruments, and do not give rise to suppuration of adjoining parts.

Prolapse of "Vitreus" and Loss of "Vitreous."—Much vitreous may be lost without finally impairing vision. (See *Extraction of Cataract.*)

CYSTICERCUS (C. TELÆ CELLULOSÆ) IN THE DEEPER PARTS OF THE EYE.

The cysticercus has been observed in all parts of the eye. The ages of the patients have varied between 20 and 60. The greatest number were from 20 to 30 years of age. Some of these had suffered from worms in childhood (oxyuris and ascarides), others from tænia (lata?), for some time previous to the eye having become affected. In several cases no worms can be traced. The cysticercus has been found in the vitreous chamber, and in, upon, and beneath the retina.

Vision may be lost within a fortnight after the appearance of the entozoon. For a varying period this may be preceded by impairment of vision confined to certain parts of the retina, so that, *e.g.*, objects can be perceived better in some directions than in others; or a mist, which gradually becomes thicker, may appear to intervene between the affected eye and objects.

Flashes of light, fiery circles, etc., were complained of by some of the patients in whom the entozoa were visible beneath the retina. In several cases the appearance of the entozoon was preceded (for years) by severe headache.

The cysticercus, when in the vitreous chamber, appears as a bluish-gray vesicle, occupying some part of the chamber. It has a limited undulating movement of its own (contraction and dilation), which is independent of the movements of the eye.

This vesicle (by a circular indentation in some part of it) is separated into a large portion (the body) and a smaller one (the head), which latter, when protruding, brings into view the long, thin neck.

In older cases one or several vesicles are visible near the cysticercus. In one case the hooklets (one being in the middle and two at the sides) could be distinguished.

Fine peculiarly continuous, grayish-opaque membranes ("opacities") are found round the cysticercus soon after its appearance in the vitreous chamber. These increase during its growth.

Only in a few cases have these opacities been missing. In such cases the entozoa were seen changing their places in the vitreous chambers.

Iridectomy, followed by extraction of the entozoon, should be tried in all cases in which the entozoon is distinctly visible and only surrounded by semi-transparent opacities, especially as long as some vision is likely to be saved. The incision for its removal is made through the equatorial part of the sclerotic, if all vision is lost.

The cysticercus, when appearing in the retina (in and beneath which it has primarily been observed), always gives rise to displacement of that membrane. It may thus be easily overlooked. When it is situated beneath the displaced retina, we find, on careful examination with the ophthalmoscope, that in addition to the floating displaced retina with its bloodvessels, a sharply-defined line is visible beneath some part of the retina. On tracing the continuation of this line it can be recognized as the outline of a vesicle (the body of the cysticercus being about four times as large as the optic disk). The choroid near the entozoon assumes a gray or yellowish-opaque color.

Sometimes the undulating movements of the entozoon can be recognized; these are independent of the movements of the displaced retina. A white dot on one part of the vesicle represents the head. The latter, with the neck, seemed in one case to move to and fro in a kind of tube formed by membranous "opacities."

The cysticercus generally perforates the retina. In several cases a greenish or yellow and opaque line in the retina (at some distance from the entozoon) has seemed to have been the spot through which it has passed into the vitreous chamber.

In one case a kind of capsule had formed round the cysticercus, after which it remained stationary, not giving rise to further inflammatory symptoms.

Choroido-iritis, yellowish aqueous humor with sluggish pupil, discolored iris, and a yellow metallic reflection from behind the pupil, have occurred as frequent complications. Within from six months to two years shrinking of the eyeball follows.

Entozoa have not yet been observed in both eyes of the same person.

HEMORRHAGE (EFFUSION OF BLOOD) INTO THE VITREOUS CHAMBER.

Blood, when penetrating into the vitreous substance, breaks up the latter and remains almost fixed in its position, until secondary changes and the movements of the eye lead to its becoming more mobile.

The opacities, as observed with the ophthalmoscope after hemorrhage, are partly caused by blood, partly by displacement of the elements of the vitreous substance, and by subsequent chemical changes of the latter and of the blood.

Hemorrhage in the equatorial region of the vitreous chamber, or close behind the lens, gives rise to the complaint of objects appearing surrounded by a mist, and to impairment of the functions of the retina adjoining the effused blood.

Rarely is the hemorrhage so considerable as to occupy a large portion of the vitreous chamber, and to reduce vision to perception of light. It is in such cases that it is mostly observed in both eyes either simultaneously or in succession.

Large clots of blood soon become freely movable in the vitreous chamber. They settle during sleep at the most depending portion of the chamber, and the patient, on getting up, finds that vision is much clearer. Movements of the eye disturb the clots, which is often accompanied by a sensation of aching.

When ascertaining the state of vision, especially in hemorrhage following injury, we must remember that displacement of portions of retina may likewise have occurred.

Though the lower portion of the retina is the part which suffers most frequently, any other part may become displaced by injury. It is probable that the retina is either detached, or has otherwise been injured, if we find the sensibility to light of any portion, especially the lower parts of the retina, destroyed or much diminished.

Treatment.—Among remedies which have been found of use in the removal of blood from the vitreous chamber, can be recommended the local use of atropia (continued for months), and the operation of iridectomy (whether there be increase of tension or not). In hemorrhage into the hyaloid fossa, the removal of the lens, and the laceration of that fossa, have been practised with success. In several cases of extensive hemorrhage, reducing vision to perception of light, a large iridectomy has been followed by complete recovery of sight.

THE IRIS AND THE CHOROID.

THE IRIS.

ANATOMICAL AND GENERAL REMARKS.

The more important parts which enter into the structure of the iris are the contractile fibres, the elastic fibres, the pigment, the elastic laminæ, the epithelium, the bloodvessels, and the nerves.

The *contractile fibres* are pale, very thin, undulating and nucleated; the nuclei are round, or oval. Mingled with these fibres are found others resembling very fine hairs, and containing numerous round nuclei.

The contractile fibres have a circular arrangement near the margin of the pupil, and are termed *the sphincter of the pupil*. At some distance from this, nearer the insertion of the iris, a smaller circle of fibres is observed. The fibres which radiate from those of the sphincter are termed *the dilator of the pupil;* they are not well marked. The extreme margin of the pupil is thin.

The Elastic Fibres.—These have their origin in that portion of the posterior elastic lamina of the cornea which faces the aqueous chamber. The fibres form part of the anterior surface of the iris, and are the chief means of its attachment behind the cornea.

The *pigment cells* are found among the contractile fibres, and contain yellow, brown, or blue pigment granules. The posterior surface of the iris is occupied by "*the uvea*," which consists of one layer of so-called epithelial cells. Each cell encloses a number of brown granules, similar to those in the hexagonal cells of the choroid.

The Bloodvessels.—The two anteriæ ciliares longæ, and some of the arteries of the choroid, supply the ciliary muscle and the iris. These vessels possess a well-marked muscular layer, and near the insertion of the iris, as well as close to the margin of the pupil, have a somewhat circular arrangement (circulas arterialis minor). In other parts of the iris their course is also somewhat similar to the arrangement of the contractile fibres.

The veins pass from the iris backwards, between the ciliary processes, and anastomose with the numerous veins which occupy the part of the ciliary processes near the ora serrata. In their course they receive veins from the ciliary processes, and some from the ciliary muscle. They also anastomose with those of the circular sinus.

The nerves follow the vessels in their course. They are derived from the third, from the ophthalmic, or 1st division of the fifth (which is the sensitive nerve of the iris), and from the sixth and sympathetic nerves. (See *Ciliary Muscle.*) Some suppose that the filaments of the third nerve, which act during accommodation, come from a different part of the brain to those which induce reflex movements of the iris. The "sphincter" of the pupil is not solely supplied by nerve-filaments from the third, nor the "dilator" by filaments from the sympathetic nerve. There merely exists a difference in quality, *i.e.*, one kind of nerve-filaments is more numerous in the one set of contractile fibres than in the other.

The action of these two nervous supplies is regarded as antagonistic: for instance, if the influence of the third nerve is suspended, then the sympathetic produces a greater effect.

The Elastic Laminæ and Epithelium.—Upon the anterior surface of the iris there is one layer of round, flat, epithelial cells, separated from the iris by a very thin, transparent membrane (elastic lamina); a similar, though somewhat thicker, membrane intervenes between the iris and uvea.

The following terms are made use of in the description of morbid and other changes of the iris:

The Anterior and the Posterior Surface of the Iris.—The former faces the anterior, the latter the posterior aqueous chamber.

The somewhat circular elevation upon the anterior surface near the margin of the pupil is caused by a circle of arteries, which, when light is thrown obliquely upon the iris, produces a shadow that is hardly perceptible in myopic persons.

Part of the posterior surface, from the uveal margin of the pupil to near its insertion, glides upon the capsule of the crystalline lens during the alterations in curvature of the latter.

Insertion of the Iris.—The iris has its insertion about $\frac{1}{14}$ inch behind the outer margin of the cornea.

The attachment of the anterior surface is effected by elastic fibres, that of the posterior surface by uvea and a transparent membrane, which intervenes between uvea and iris, and also between iris and ciliary muscle. This membrane, together with the tendon of the above muscle, is attached to the walls of the circular sinus at the point where the fibrous and the elastic portions of the walls of the sinus meet.

Margin of the Pupil.—We shall have occasion to speak of the uvea (posterior) margin (the one which glides upon the capsule of the lens), and of the anterior margin (the one which faces the cornea).

The Pupil.—Most of the natural and morbid changes of the eye reflect themselves in the state of the pupil. The alterations of its size, shape, and color assist us in our diagnosis, not only of changes in the iris, but of numerous ocular and cerebral anomalies. Light thrown upon the healthy retina causes contraction of the pupil by reflex action of the optic nerve in the brain (in the corpora quadrigemina, which are considered as reflex centres), upon the third nerve.

Examination.—The choroid, when examined with the ophthalmoscope in the healthy living eye, presents many peculiarities. It differs in appearance as regards color in "dark" and "fair" persons. From the color of the iris we can foretell that of the choroid. The contrast between the brilliant red color of the choroid in the eye with blue iris, and the almost neutral tint of the one with black iris, is very striking.

The color of the choroid is one of the most striking features of the interior of the living eye. The brilliancy of the generally red color depends upon the quantity and degree of tinting of the pigment, and upon the blood circulating in the choroid.

The greater the quantity of light which is reflected from the inner surface of the sclerotic, and which returns through the choroid, retina, etc., to the observer's eye, the better can the details of the choroid be recognized. The sclerotic is to the choroid what the silvering is to the glass of a mirror.

The more pigment there is in the choroid, the less light passes through it; and the less can the details of the interior of the eye be recognized with the ophthalmoscope.

Any opaque substance (clots of blood, etc.) intervening between choroid and sclerotic prevents our seeing that part of the sclerotic and choroid.

To be able to examine the choroid thoroughly, the pupil should be well dilated. The whole of the choroid, from the optic disk to near the ora serrata, can be seen with the ophthalmoscope, and, in albinos also, the tips of the ciliary processes. Particular attention should be paid—(1.) To "*the choroidal aperture*," *i.e.*, to the choroid where it surrounds the optic disk. (2.) To *the region of the yellow spot*, which is readily seen by directing the patient to look at the sight-hole of the ophthalmoscope. (3.) To *the equatorial region*, which becomes visible on looking slantingly into the eye.

The details of the structure of the choroid which can be recognized by direct ophthalmoscopic examination are, groups of hexagonal cells, groups of stellate pigment cells; the veins (venæ vorticosæ), and the ciliary arteries.

The hexagonal cells (*i.e.*, their pigment granules) appear more transparent when the light traverses them obliquely; and more so in some eyes, or in some parts of the same eye.

The granules of many cells have a deeper brownish tint. Groups of such cells, when standing side by side with cells containing less tinted granules, cause the inner surface of the choroid to appear sprinkled with groups of minute brown spots. The recognition of the situation of the hexagonal cells is an important means of localizing morbid changes in other parts of the choroid and retina. Morbid changes, occurring in these tunics, hardly ever fail to be accompanied by alterations in the hexagonal cells.

The groups of stellate pigment cells, which occupy the spaces between the veins of the choroid, appear as small, defined patches, varying in color from light to dark brown. The peculiar honeycomb appearance of a strongly-pigmented anæmic choroid is produced by the pigment patches which surround the nearly empty veins. An abundance of these strongly-tinted stellate pigment cells, when intervening between the veins and the hexagonal cells, gives the choroid a more uniform brown-red color.

Coloboma of the Choroid.—The existence of the coloboma is diagnosed with the ophthalmoscope. Coloboma of the choroid is always accompanied by anomalies of the retina, with corresponding impairment of vision, and by an abnormal shape of the eyeball.

The sclerotic, instead of assuming the natural curvature and thickness, remains thin and bulged (staphylomatous) in some of the parts formerly occupied by the fœtal fissure. The oval, elongated shape of the myopic eye is thought to depend upon this condition, though it must be remarked that coloboma has also occurred in highly hypermetropic eyes. The most striking change observed with the ophthalmoscope is a brilliant white figure about the region of the optic disk, extending, however, in extreme cases, forwards to the ciliary processes, or even to a coloboma in the iris.

This figure presents a variety of shapes. Sometimes we find it close to the optic disk, and resembling a brilliant gray or bluish-white atrophic optic disk. The pink color and the retinal bloodvessels assist in recognizing the optic disk itself.

The white figure is the result of incomplete closure of the sheath of the optic nerve where it joins the sclerotic, and of the tunics immediately adjoining it.

A nearly transparent membrane (? the retina) may sometimes be seen extending from the margin of the optic disk over the white figure.

Irideremia, or Absence of the entire Iris.—Varieties of irideremia are:—(1.) Absence of all the parts of the iris except the uvea; and (2.) Absence of the circular fibres, or of the radical fibres, of the iris.

Irideremia, as a rule, occurs in both eyes, and is frequently complicated with peculiar opacities of the cornea, together with "cataract;" sometimes with atrophic changes of the optic disk, and absence of the retinal bloodvessels.

With the ophthalmoscope we readily see the margin of the crystalline lens, and the space intervening between it and the ciliary processes.

Vision.—Patients have been known to pass through life, and to attend to their work, without applying to the oculist. They sometimes seek assistance when presbyopia sets in. Stenopæic spectacles, and those with convex lens, have been found of service.

Persistence of the Pupillary Membrane.—Portions of this membrane are frequently met with upon the anterior surface of the circular fibres of the iris, near the pupil. They generally encroach upon the area of the pupil, as grayish-white and opaque filaments. If adherent to the capsule of the crystalline lens, they are found relaxed during contraction, and stretched during dilation, by the pupil. In one case, the entire pupil was found masked by the perforated pupillary membrane. In another case, the entire iris and pupil were partially obscured; through holes in the membrane, the pupil could be seen to contract and dilate normally.

Displacement of the Pupil.—Occurs most frequently upwards. Displacement of the pupil behind the margin of the crystalline lens has been observed. An irregularly-shaped (frequently oval) pupil is sometimes the sequel of intra-uterine iritis. Too small a pupil with tremulous iris, and too large an one, have occurred.

Several Pupils.—Cases are recorded of two or three pupils occurring in the same iris, either near the natural pupil, or more towards the insertion of the iris, all becoming dilated by belladonna. An explanation of this anomaly may be found in the fact that the iris at first is attached to the choroid, not in a continuous line, but by numerous isolated fibrillæ.

Anomalies in Color.—The iris of one eye may have a brown, and that of the fellow-eye a bright yellow, or a blue color. It is not uncommon to find one-half of the iris to have a blue, the other a brown color.

The circular fibres of the iris frequently differ in color from the radiating fibres.

In a brown iris the margin of the pupil is lighter, and in a blue one darker, than the other parts.

White opaque, frequently concentric, lines occur on the surface of the iris, near its periphery. Pigmentations, generally of a rust color, are met with upon the iris midway between the pupil and the insertion of iris.

INJURIES OF THE IRIS AND THE CHOROID.

Incisions, dividing the radiating fibres of the iris transversely, if made in a direction parallel with the fibres, can, even with the ophthalmoscope, only be recognized with difficulty.

Separation of the iris from its insertion, however small, betrays itself by irregularity of the pupil. The separated portion never becomes adherent again.

Rupture of the sphincter and of the margin of the pupil have given rise to traumatic coloboma.

Hyperæmia follows these injuries, but rarely iritis.

Rest of the injured eye and of the sound eye, if inconvenience is felt from using it, and the local treatment for iritis are required, and continued until all undue vascularity has disappeared.

Prolapse of the iris, when it occurs through a wound in the cornea or sclerotic, should, if covered by conjunctiva and not bulging, be left alone; but, if bulging, it should be punctured with a needle, and the collapsed protruding portion should be seized with the forceps, and removed with scissors.

Care must be taken not to cut off the protruding iris too close to the eyeball, but to leave a little along the margin of the wound, or else a fistula may remain.

Rest of the eye and closure of the lids by a bandage are required, until all undue vascularity has subsided.

A large prolapse of the iris may be changed into a flat cicatrix by puncturing it in numerous places every second or third day.

Foreign bodies in the iris, whether visible or merely suspected to be there, require the immediate performance of iridectomy to remove the injured or suspected portion of iris. (See, also, *Traumatic Cataract.*)

Concussion of the iris by blows, etc., may cause—

(1.) Mydriasis. In every case we should ascertain with the ophthalmoscope the state of the deeper parts of the eye. By making the patient look through a small opening, we determine whether the impairment of vision is due to the mydriasis only.

If vision (tested by these means) is found normal, no immediate fear need be entertained.

The eye is kept at rest, and Calabar is applied locally, if, after a few weeks, the pupil has not resumed its natural size and mobility.

(2.) Partial or complete disappearance of the iris. This has been observed after blows on the eye, causing partial or entire dislocation of the vitreous substance and of the crystalline lens, these being simultaneously rotated within the area of the retina. The iris, or part of it, becomes drawn backwards, and is kept out of sight through vitreous substance pressing it against the ciliary processes.

In an eye with apparent absence of the iris (which had been blind for years), a chalky lens was seen rolling about in the hyaloid fossa, whilst the iris, after excision, was found pressed upon the ciliary processes by aqueous humor.

Rupture of the sclerotic is often accompanied by displacement of the portion of iris adjoining the seat of injury.

The kind of *injury of the choroid*, which have come under observation, have been perforating wound; concussion of the choroid; foreign bodies (pieces of metal, glass, etc.) lodged in or near the choroid; and injuries of adjoining tunics, secondarily implicating the choroid.

The regions of the choroid most frequently injured are the ciliary region, and the one above and below the yellow spot.

The morbid changes following injury of the choroid vary according to the general health of the patient, the nature of the injury, the parts injured, the state of the eye previous to the injury, and the treatment adopted.

The same kind of injury may be followed by suppurative choroiditis in a weak person, which in a strong one gives rise to a less destructive form of inflammation.

A foreign substance lodged in the choroid gives rise to a graver injury than an incised wound, or a concussion of the choroid.

Injuries about the region of the yellow spot are more serious, in consequence of their frequently implicating parts of the retina which are essential for direct vision; and injuries about the ciliary region, in consequence of their giving rise to sympathetic changes.

An injury of the choroid of an eye, which previous to the injury was neither "glaucomatous" nor otherwise morbidly altered, is less grave in its consequences than one occurring to an unsound eye.

The morbid changes most frequently observed in the choroid after injury are—Hemorrhage (see *Hemorrhage into Choroid*); Suppuration (see *Ophthalmitis and Choroiditis*); Plastic Choroiditis (see *Choroiditis*); Glaucoma.

Rents in the Choroid.—Owing to some peculiarity in the structure of the choroid, we find the margins of the rent wide apart if the rent runs transversely; *i.e.*, if it has a direction parallel with the margin, *e.g.*, of the cornea.

Rents of the choroid have been observed after concussion of the eyeball by blows, without any of the other tunics appearing ruptured. Viewed with the ophthalmoscope, the rent appears as a white, or brilliant white, irregularly-shaped surface. Its long axis runs somewhat parallel with the margin of the cornea. It is skirted by pigment spots, and retinal bloodvessels may be seen passing across its area.

The treatment of injuries of the choroid is, in a great measure, included in that of the morbid changes which follow the injury.

Foreign bodies lodged in or near the choroid have repeatedly been removed successfully.

The injured eye, and the fellow-eye, if sympathetic irritation appears, should, in all cases, be kept at absolute rest until all signs of irritation or of inflammation have disappeared.

TUMORS OF THE IRIS.

Tumors advancing from the deeper parts of the eye, in their course often implicate the iris. (See *Orbit, Tumors in the*, etc.)

The following are instances of tumors originating in the iris:—

A globular tumor, with a dirty-yellow, flocculent surface, and consisting of myeloid corpuscles and connective tissue. In one case the tumors increased in size, and finally became complicated with hypopyon, corneitis, and perforation of the cornea. Some time later this was followed by shrinking of the eye.

A whitish tumor (diameter $\frac{1}{10}''$), with a shining surface, projecting from the anterior surface of the iris near the margin of the pupil, was removed. It proved to be covered with epithelium, and to contain a white chalky substance, and a few short hairs.

Sebaceous tumors have been known to cause circumscribed suppuration of the iris and the cornea.

A small pigmented tumor of the color of the uvea, near the margin of the pupil, has been observed. It accompanied the movements of the iris.

Cysts (situated near the margin of the pupil) enlarge very slowly at first; they become painful as they increase, and resemble the bulging of a circumscribed portion of iris, as is sometimes seen after severe iritis with synechiæ. The cyst or cysts may at last come in contact with the cornea; and sometimes occupy the entire anterior chamber, and hide the pupil. They are generally situated between the uvea and the fibrous part of the iris.

When punctured fluid escapes, the cysts collapse and the iris resumes its natural appearance. They fill again, and do not always disappear after repeated puncturing.

A cysticercus appearing in the shape of a small black nodule, and attached to the anterior surface of the thickened and vascular iris, has been removed successfully.

For tumors of the choroid, see *Orbit—Tumors of the Orbit and Eyeball.*

PARALYSIS.

The iris, if completely paralyzed, is tremulous (iridodonesis); and the pupil of the medium size, and fixed.

Mydriasis signifies an abnormal dilation; *myosis*, an abnormal contraction of the pupil.

Mydriasis, or abnormal dilation of the pupil, may rise from—

(1.) Paralysis of those branches of the third nerve which supply the iris. This condition by some is termed the *paralytic*, to distinguish it from the *spasmodic* form of mydriasis.

The pupil is not dilated to its utmost. It remains fixed when exposed to bright light and during accommodation. It often contracts somewhat when the external rectus muscle (supplied by the sixth nerve) acts.

(2.) Irritation of the sympathetic nerve. This gives rise to greater dilation of the pupil than the preceding.

The cause of mydriasis may be—glaucoma,—injuries,—morbid changes of the brain, as hydrocephalus, meningitis, or hemmorrhage at the base of the brain,—poising by gas, by belladonna, hyoscyamus, niger veratrum album, æthusa cynapium, strych-nia, cicuta virosa, digitalis purpurea, hydrocyanic acid.

Mydriasis, if confined to one eye, is generally caused by changes in the eye itself, or by circumstances acting locally upon the eye. The pupil is either fixed or sluggish, and often irregularly dilated; while the fellow-pupil appears unusually contracted. Mydriasis is generally combined with paralysis of the ciliary muscle, and often with paralysis of other muscles supplied by the third nerve. It has been observed to be the forerunner of mental derangement.

Treatment.—The local application of Calabar should be tried in all cases of non-glaucomatous origin, and should be continued as long as improvement of vision is observed. The "mydriatic" eye, if it resists Calabar or interferes with the use of the other eye, must be kept closed.

Vision is often but little disturbed if the mydriasis is confined to one eye. Patients complain of the light being too dazzling, and of inability to distinguish near or small objects. In the selection of spectacles for reading, we must be guided by the existing state of refraction and accommodation.

Mydriasis, as a symptom of increased tension, comes under the treatment of glaucoma.

We should direct our attention also to the cerebral changes that may exist or threaten.

Myosis, or Abnormal Contraction of the Pupil.—Myosis generally exists in both eyes. It may be of the spasmodic or of the paralytic kind. When of the former variety, the pupils respond to the agents which produce dilation.

As causes have been observed:—(1.) Hyperæsthesia of the retina, brought on by continued work at small objects.

(2.) Paralysis or paresis of the branches of the sympathetic nerve, which go to the iris (with or without irritation of the third nerve); from morbid changes about the medulla oblongata (as precursor of spinal amaurosis); or from pressure upon the sympathetic nerve in the neck (by large tonsils, or by aneurism of the subclavian artery).

(3.) Spinal or cerebral disease.

(4.) Long-continued and close work.

(5.) Contraction of the pupil, following division of the fifth nerve, is probably a reflex action of the irritated cerebral portions of the third nerve.

Treatment.—Solutions of atropia, of varying strength, may be tried (to dilate the pupil to a moderate extent), if the diminution of the field of vision and the desire for light are great.

In some cases of cataract with myosis, the latter resisting atropia, iridectomy has had to be performed previous to extraction, in order to enable the cataract to pass in front of the iris.

ANOMALIES AND ACCOMMODATION.

The anomalies of accommodation which arise from abnormal changes of the crystalline lens are described under *Presbyopia*, under *Dislocation of the Lens*, and under *Aphakia*. We shall treat here of those which arise from disturbed action of the ciliary muscle itself, and distinguish—(1.) Paralysis or paresis. (2.) Weakness. (3.) Spasm.

PARALYSIS OF THE CILIARY MUSCLE.

Causes and General Remarks.—We must, if both eyes are affected, look for a central cause (cerebral disease, syphilis, tumors).

The immediate cause is paralysis of the nerve-fibres which supply the ciliary muscle. In a large number of cases, we find simultaneous paralysis of other fibres of the third nerve, producing ptosis, and paralysis of the external muscles of the eye.

The iris and ciliary muscle are very rarely found unaffected when other parts supplied by branches of the third nerve are paralyzed; and again, paralysis of all the branches of the third nerve is uncommon; while paralysis of the ciliary muscle (of the accommodation) and of the iris alone is not unfrequent. In the latter case only the short root of the ciliary ganglion is paralyzed.

This paralysis has been observed at all ages, but more frequently in young and in middle-aged persons. In all cases we should examine the functions of other nerves (of the fourth, sixth, and also of the fifth nerve).

Symptoms.—(1.) Loss of contractility of the sphincter of the pupil. The pupil is immovable, of medium dilation, and accommodative and reflex movements are absent. The pupil may remain slightly movable (paretic) while the accommodation is paralyzed; or, on the contrary, the latter may be found tolerably good while the pupil remains fixed.

(2.) Loss of contractility of the ciliary muscle. Vision at distance is generally normal, unless there is some anomaly of refraction. Vision for near work, reading, etc., is more or less disturbed if only one eye is affected; it is impossible if both eyes are implicated.

Myopic persons, who wear spectacles, are as much inconvenienced as emmetropics; while, if no spectacles are worn, and the myopia is such that the farthest point of distinct vision lies about at the distance at which the book, etc., is held, little disturbance is felt. Patients sometimes complain of objects appearing too small, and, if the recti muscles are implicated, of their appearing to move. Patients also mistake the position of objects.

Treatment.—The constitutional changes which may give rise to the paralysis are syphilis, rheumatism, general weakness following severe illness, etc.; these require appropriate medical treatment.

The local treatment, if only one eye is affected, consists in the application of Calabar until the accommodation is restored. Calabar should also be tried if both eyes are affected, though it is of little use if the cause of the paralysis be cerebral.

Spectacles with convex lenses are necessary for work. The lenses should be of the focal distance at which the patient wishes to see distinctly when at work, *e.g.*, spectacles with lenses (each lens having a focal distance of 16″) are required if work has to be performed at that distance.

The local treatment of paralysis of other branches of the third nerve has to be combined with this.

PARESIS OF THE CILIARY MUSCLE—PARESIS OF ACCOMMODATION.

Causes.—Paresis is frequently observed after acute disease. A cause which of late has attracted much attention is diphtheria. The paresis appears suddenly after the specific lesions of diphtheria have nearly, or quite, subsided. Accommodation and speech are often the only functions impaired. Other causes of paresis are those enumerated under paralysis.

Myopic persons, who do not wear spectacles, may experience no inconvenience if the myopia is such that the farthest point of distinct vision lies at about the distance at which reading, work, etc., is performed.

Paresis of accommodation may be mistaken for asthenopia.

Paresis appears rapidly within a few days or weeks; asthenopia has often existed for years before the patient seeks advice. In paresis prolonged vision of distant objects causes no inconvenience. Near objects cannot be recognized, or only with difficulty; fatigue appearing almost immediately after the attempt has been made to see them distinctly.

In asthenopia, on the contrary, fatigue appears after prolonged vision of distinct, as well as of near objects. Objects can be recognized distinctly for some time, though vision be painful.

Treatment.—The treatment is similar to the one adopted for paralysis. Besides the local application of Calabar, we may try secale cornutum, to be given in ten grain doses (with carbonate of magnesia, or with iron) four times daily for a few weeks.

SPASM OF THE CILIARY MUSCLE—(PAINFUL VISION).

The characteristic symptom of spasm of the ciliary muscle is pain felt in the eyes, *e.g.*, during "near work" ("during tension of the ciliary muscle"), or after application of a strong solution of Calabar. The pain continues during tension of the muscle; it subsides after repeated application of atropia. The pain may be so severe that all work has to be discontinued: it often appears suddenly, and is accompanied by myosis.

Causes of painful contraction of the ciliary muscle are:—

(1.) Insufficiency of the internal recti muscles, with hypermetropia.

(2.) Frequent efforts at accommodation for the nearest point of distinct vision, as occur in amblyopic and in astigmatic persons.

(3.) Moderate degrees of hypermetropia, inducing persistant efforts to overcome the hypermetropia.

(4.) Myopia, partly from undue tension of the accommodation during prolonged work, partly from hyperæmia within the eye, extending to the ciliary muscle.

Treatment.—Near work, reading, etc., may have to be discontinued for months if the treatment of the cause (*i.e.*, the anomely of refraction or the insufficiency of the recti muscles) does not, within a few weeks, remove the pain and make prolonged work easy. Spectacles must then be laid aside; and the ciliary muscle must be thoroughly paralyzed by atropia, and kept in that condition. Spectacles, with tinted convex lenses, may be given to hypermetropic persons for going about. Plain tinted glasses are ordered for the same purpose in all other cases.

IRITIS (INFAMMATION OF THE IRIS).

GENERAL REMARKS.

Different forms of iritis have received special names, some of which are derived from the cause (such as syphilitic, traumatic, etc., iritis); others from the course (as acute, chronic, recurrent, etc., iritis); others from the "inflammation" (as suppurative, serous, plastic, etc., iritis).

In each special form of iritis we meet with symptoms which occur in every case of iritis, and with symptoms which characterize the special form.

The symptoms of simple iritis are always mixed in varying degrees with those of the special forms; so also those which are characteristic of a special form of iritis may pass away, and the case run on as one of simple iritis. This should be borne in mind when treating iritis. A trial should be given in all cases to a combination of the local treatment of simple iritis with any general medical treatment that may be thought fit.

The symptoms characteristic of the special forms are:—for syphilitic iritis, the separate nodules of lymph—for sympathetic iritis, the unusual enlargement of the vessels of the iris;—for serous iritis, the enlargement of the pupil, combined with increased tension and increased quantity of aqueous humor.

An embolic or metastatic iritis has been described as occurring during, or soon after, an attack of measles, scarlatina, variola, typhoid or rheumatic fever; or during pregnancy, or whilst nursing, etc. The iritis in these cases is, as a rule, partly plastic, partly suppurative in character, and accompanied by inflammation of other parts of the eye. Syphilitic iritis, when occurring in very debilitated persons, may be accompanied by hypopyon, or by an abscess in the iris.

The *injuries* which frequently cause iritis of the simple or of the suppurative form are operations for the removal of cataract, and wounds or concussions of the cornea.

Iritis often appears as a complication of morbid changes in other parts of the eyeball, *e.g.*, during an attack of glaucoma, with tumors or entozoa within the eye; during choroiditis, during corneitis, etc.

SIMPLE IRITIS.

Iritis is probably always preceded by hyperæmia of the iris, with slight redness of the sclerotic adjoining the margin of the cornea, by impaired mobility, and by some discoloration of the iris. A similar hyperæmia of the iris is also observed during morbid changes in the ciliary processes, choroid, retina, cornea, and even the conjunctiva.

The presence of hyperæmia should put us on our guard, not only because it readily increases to iritis, but also because it often indicates a grave disturbance of other important textures of the eye.

The symptoms which are common to all forms, and which are characteristic of iritis, are:—

(1.) A varying amount of "plastic" material in, upon, and round the iris.

(2.) Impairment, or complete loss of mobility of the iris generally, with adhesion (synechiæ) of the uvea to the capsule of the lens.

(3.) Irregularity in the shape of the pupil.

(4.) Alteration in the color of the iris.

(5.) More or less sclerotic vascularity along the margin of the cornea. The appearance of "plastic material" or of "inflammatory products" is attended with anomalies in the nutrition and texture of the iris. The iris, near the margin of the pupil, appears most altered. The plastic material, seen with the naked eye, generally appears as a grayish, semi-opaque substance, which is diffused throughout the iris, or appears as spots of varying size. It gives rise to adhesions of the iris to adjoining parts.

The chemical properties of the aqueous humor are altered. The latter often becomes turbid from the presence of mucus and pus-corpuscles. Hypopyon may appear simultaneously. Diffused opacities, or minute spots, may occur (especially at the lower half of the posterior surface of the cornea); which are partly the results of effusion, partly of alterations in the epithelium.

The dotted opacities are characteristic of syphilis (both inherited and secondary).

The term *aquo-capsulitis*, *hydro-meningitis*, were formerly used to designate the form of iritis which is accompanied by the appearance of opaque spots upon the posterior surface of the cornea.

The quantity of plastic material may be so small that the irregularities of the pupil, which appear on the application of atropia, are the sole signs of iritis; it may be so great that the swollen iris comes in contact with the cornea. The plastic material impedes the movements of the iris; and its subsequent changes more or less destroy the texture of the iris.

The margin of the pupil, though no adhesions may exist, loses its mobility, and often its regular shape.

Synechiæ, or Adhesions of the Iris to other Parts.—We distinguish anterior and posterior synechiæ.

Anterior synechiæ, *i.e.*, adhesions of the iris to the cornea, or to textures occupying its place. Synechiæ, if occurring without perforation of the cornea, are often observed near the insertion of the iris; and are the result of the prolonged contact of the swollen and inflamed iris with the cornea. Swelling of the inflamed cornea facilitates these synechiæ.

Posterior synechiæ, or adhesions of the iris to the parts situated behind the uveal surface. They are by far the most frequent. To examine them thoroughly atropia should be applied, and lateral illumination used.

Circular posterior synechiæ exists if the margin of the entire pupil is adherent to the capsule of the crystalline lens; the area of the pupil may be free from effusion, or nearly so.

Total posterior synechiæ exists if the entire posterior surface of the iris is adherent to the capsule of the crystalline lens.

Synicesis of the pupil means closure of the pupil by a more or less opaque substance, which is continuous with the iris. This is a frequent result of iritis.

Changes in color of the iris are observed throughout the course of iritis, and are one of its earliest symptoms. A blue iris appears greenish, and a brown one of a rust color.

Large masses of lymph, or pus, or suppuration of the plastic material, give the iris a yellow appearance.

The "sclerotic redness" ("sclerotic zone," "ciliary redness") appears along the margin of the cornea. It varies from a hardly perceptible pink zone to a large crimson belt, surrounding the cornea; in severe cases it is coupled with much conjunctival vascularity, and sometimes with chemosis.

The decrease of the sclerotic zone generally coincides with that of the iritis.

Other symptoms, which vary in degree, or which may be completely missing, are:—loss of appetite, sleeplessness, pain, intolerance of light, "watering of the eye," with swelling and redness of the eyelids.

The pain is sometimes very severe, either in the eye, or forehead, or both; it may only be felt on touching the ciliary region, or may be intermittent or continuous. Leeches and atropia hardly ever fail to remove it.

The variations which occur in the course of iritis depend upon—

(1.) The quantity of plastic material (the greater the quantity the more extensive the synechiæ, and the greater the structural changes of the iris).

(2.) The health of the patient. In those whose constitutions are much shaken, we may expect suppuration and subsequent atrophy of the iris.

(3.) The period at which we undertake the treatment.

(4.) And, lastly, upon the complications which arise from changes in other parts of the eye.

Simple iritis in an otherwise healthy person, and when of moderate degree, subsides in about four weeks. The sclerotic vascularity and the plastic material gradually disappear, the aqueous fluid and cornea become clear, and the color of the iris and the mobility of the pupil (on discontinuing the use of atropia) more natural. Pigment spots upon the capsule of the lens, if not in contact with adhesions of iris, often disappear.

The changes in the structure of the iris depend upon the intensity, kind, and duration of the iritis; and also upon the number of attacks. Opaque patches and streaks upon the surface of the iris, together with changes in color, alterations in mobility (from slight loss of contractility of some parts, to complete immobility with iridodonesis), may occur. The iris may lose all elasticity, and become nearly transparent.

Complications.—Iritis is a frequent complication of morbid changes in the cornea. Deep ulcers, abscesses, or purulent corneitis, with or without hypopyon, are, as a rule, accompanied by iritis, and sometimes by suppuration of the iris.

The local application of atropia, and, still better, iridectomy, frequently arrest the corneal changes.

Changes Behind the Iris.—Cyclitis is often present with iritis. Its presence may be assumed in every case of chronic iritis, if the tension of the eye becomes increased, and still more, if subsequently it sinks below par, and is accompanied by opacities in the vitreous chamber, close behind the lens.

Simultaneous inflammation of the choroid, of the same kind as that of the iris, is equally common. With the ophthalmoscope we can often detect these changes during the height of iritis.

Treatment of Simple Iritis.—In every case, and at any stage of iritis, we should prescribe the local application of belladonna, or of atropia, to produce dilation of the pupil.

(*a.*) To prevent, as much as possible, irregularities of the pupil and synechiæ.

(*b.*) To secure rest by preventing contraction of iris and ciliary muscle.

(*c.*) To alter the tension of the eye, and the circulation in the choroid.

In slight iritis, the atropia should be applied from three to ten times daily; and if there is severe pain, every five minutes for some hours in the evening. These frequent applications are continued for from three to five days, or until pain and vascularity have become less.

The application, twice daily, is continued for from two to three weeks after all vascularity has subsided; by so doing, a relapse or a fresh attack is less likely to occur.

The pupil, in rare cases, remains dilated for weeks, or acts but sluggishly long after the application of atropia has been continued; to remove this condition, we apply Calabar. (See *Calabar and Atropia.*)

Leeches (from two to six) are applied at bedtime to the skin of the corresponding temple, if the pain is severe, and not soon relieved by atropia. Afterwards bleeding should be encouraged for one or two hours, according to the general state of health. The eyelids must be kept closed for twenty-four hours after the application of the leeches.

Tepid water should be used to bathe the eyelids morning and night, or as often as may be agreeable.

Lotio alum am., mur. ammon., equal parts, is ordered, if there is purulent discharge.

The eyes may be used for work if no pain is caused by it, or if there is no intolerance of light. Spectacles with blue-tinted glasses, or a shade, should be worn, if there is intolerance of light. (See, also, *Treatment of Syphilitic Iritis.*)

Vision.—Impairment of vision is often the sole symptom for which advice is sought. Unfortunately, several attacks of iritis may occur in the same eye, and permanently disturb the relations between the iris and crystalline lens, without sensibly impairing vision. Neglect on the part of the patient, in such a case, prevents recovery without synechiæ. The impairment varies in degree. Only a slight "mist" may appear to intervene between the object and the eye, the patient being still able to attend to ordinary work. In severe cases there may be mere perception of light.

Vision, if atropia is employed in time, becomes "worse" by the pupil becoming dilated; and this symptom, though favorable, may frighten the patient, and induce him to forego the use of the atropia. We should warn the patient against this, and explain the object and effect of the remedy used.

The causes of impaired vision, if the iritis has completely subsided, must be sought—

(1.) In the disturbed transparency of the cornea or pupil, or capsule of the crystalline lens.

(2.) In changes of the iris or ciliary muscle.

(3.) In complications arising from either the crystalline lens, vitreous substance, choroid, or retina.

(4.) And lastly, sometimes in orbital or cerebral disturbances.

If only one eye has been affected, we should use those medical, surgical, or optical means, which render this eye, as regards vision, as useful as possible. Thus, after the cessation of iritis, we may have occasion to treat corneal opacities, posterior synechiæ, closed pupil, cataract with closed pupil, impaired accommodation with undue hardness of an otherwise transparent crystalline lens, cyclitis, etc.

(1.) Adhesions of the iris to the crystalline lens (posterior synechiæ) impede the movements of the iris and crystalline lens, and interfere with accommodation. They give rise to astigmatism, and occasionally to troublesome polyopia.

Loss or great impairment of mobility of the iris is said to produce hemeralopia (from the inability of the pupil to dilate at dusk), and occasionally sympathetic irritation of the healthy fellow-eye.

(2.) In children, several rents (spontaneous artificial pupils) have been observed in the iris. These may be the results of adhesions opposing the growth and movements of the iris.

(3.) Pigment and opaque spots upon the capsule of the lens intercept or diffuse the light, and may give rise to intolerance of light, or to "muscæ." If occluding the pupil, they may reduce vision to mere perception of light. The amount of light which can still be perceived (together with the power of indicating the direction from which the light is thrown upon the iris) may be the sole means of ascertaining the degree of sensibility of the different parts of the retina.

(4.) We often find, especially in total posterior synechiæ, portions or the whole of the anterior surface (fibrous part) of the iris, or, more rarely, the entire lens, pushed forwards, "or bulged." The pupil appears drawn back while the bulging portions of iris sometimes touch the cornea; behind these fluid is accumulated. This condition must not be mistaken for displacement of the iris and crystalline lens towards the cornea, as is sometimes observed in cyclitis.

The "bulging" of the iris may be followed by glaucomatous changes—*viz.:* increased tension of the eye; anæsthesia of the cornea; paralysis, at first of the peripheral parts of the retina, finally followed by loss of vision and cupping of the optic disk, etc. At a still later period atrophic changes appear, with decrease of tension, chalky cataract, and atrophy of the tunics, etc.

A few synechiæ interfere but little with vision; the application of atropia, continued for several months, causes them sometimes to become torn through. The synechiæ can, if desirable, be removed by corelysis.

If many synechiæ exist and interfere with vision, or, if they are the results of recurrent iritis, iridectomy with corelysis should be performed.

Synechiæ, with occlusion of the pupil, with or without bulging of the iris, often require the combination of iridectomy with removal of the crystalline lens, unless we succeed in removing the uvea from the capsule of the lens. In all cases we must be prepared to find uveal pigment adherent to the capsule, and always examine for it by lateral illumination. The non-removal of the uvea, together with the fibrous part of the iris, is a frequent cause of failure of iridectomy, or of the operation for artificial pupil. By a thoroughly-performed iridectomy communication is established between the aqueous chambers; and a favorable change frequently occurs in the nutrition of the choroid, retina, and vitreous substance.

No benefit is derived from any operation if the eye is soft, and vision so impaired that, *e.g.*, a strong flame of gas-light held close to the eye is barely perceived, or only in certain directions. The operation of iridectomy may, however, be recommended, if the flame can be perceived at from six to ten feet from the eye, and if, at the same time, the peripheral parts of the retina are sensitive.

SYPHILITIC IRITIS AND SYPHILITIC CHANGES OF THE STRUCTURE BEHIND THE IRIS.

SYPHILITIC IRITIS.

This form of iritis is frequently confined to circumscribed portions of the iris. The pupil is contracted, generally irregular, and acts sluggishly. The inflamed portions of iris appear swollen, reddish, and soon become covered with the characteristic yellowish, or reddish, or brown nodules termed "lymph-nodules." These, when examined quite fresh, consist of closely-packed connective tissue corpuscles (?), enlarged capillaries, new vessels, and deep brown or black pigment granules.

The lymph-nodules may fill the area of the pupil, and in severe cases obscure the greater part of the iris; they may touch the cornea or sclerotic, and give rise to infiltration and perforation of the tunics. They may undergo suppuration, and destroy the entire iris. They disappear gradually; their place becomes occupied by gray opaque tissue, which in its turn may become "absorbed."

This form of iritis is most common between the ages of twenty and forty, but it not unfrequently occurs in infants between the ages of two months and one year. In these, as well as in adults, we rarely fail to discover other syphilitic symptoms.

Beyond this peculiar stage the iritis does not present any feature characteristic of syphilis, although the existence of posterior synechiæ, together with contracted and irregular pupil, should always make us treat it as such.

The usual absence of redness of the eyelids, and the slight sclerotic vascularity, often cause iritis to be overlooked by the patient when confined to one eye. (See *Simple Iritis.*)

Syphilitic iritis, especially if the first attack has been a severe one, often recurs, and sometimes with remarkable periodicity, though it is rare during any of the subsequent attacks to meet with the characteristic "lymph-nodules."

Treatment.—*Mercury.*—A small quantity (about the size of a large pea) of the unguent. hydrarg. nitrat. mitius is rubbed into the skin of the forehead at bedtime, until all undue vascularity of the eye has disappeared. The use of the ointment is discontinued if the gums should become affected.

For infants we prescribe one grain of the hydrarg. c. creta, to be given daily for from five to ten days.

Bromide of potassium is an excellent remedy, in doses from 5 to 10 grains 3 or 4 times daily, for an adult.

℞. Potassa Bromide, -------------------- ʒiv.
Syr. Aurantii, ----------------------- ℥iv.

Mix. A teaspoonful four times a day.

Some recommend from one-sixth to one-third of a grain of morphia, at bedtime, after the bowels have acted.

Turpentine (in five-grain doses three or four times daily) has been found of use in weak persons suffering from frequent attacks of iritis, and in chronic iritis of so-called rheumatic character, with much sclerotic and subconjunctival vascularity.

The local treatment is that of simple iritis.

Iridectomy.—No benefit is derived from this operation in simple, nor in syphilitic iritis, nor in cornea-iritis, as long as fresh plastic material or lymph makes its appearance; the new pupil becomes closed again with plastic exudation.

Some describe a *gonorrhœal iritis*, the peculiarities of which are stated to be, excessive pain, intolerance of light with profuse flow of tears and disky sclerotic redness, the iritis being preceded by gonorrhœa, with effusion into the joints. Mercury and atropia were found of no use.

SYPHILITIC CHANGES IN THE STRUCTURES BEHIND THE IRIS.

If a person shows symptoms of syphilis, *e.g.*, of the skin, or in the cornea, or iris of one eye, and complains of impairment of vision of the externally healthy fellow-eye, we often discover syphilitic changes in the deeper structures of the other eye. These changes are in most cases characteristic of syphilis.

It is usual in inherited as well as in secondary syphilitic inflammation of the deeper structures, to find several of these structures inflamed simultaneously. The name by which the inflammation is described is derived from the structure which appears most altered. Thus, we speak of syphilitic choroiditis, choroido-iritis, retinitis, etc., though the vitreous, or lens, or sclerotic., etc., may participate in the same inflammatory changes.

From this point of view we meet in order of frequency with—

(1.) Choroiditis (of which the choroiditis disseminata is one form).

(2.) Inflammation of the optic disk and of the choroid and retina immediately adjoining.

(3.) Inflammation of the vitreous substance.

As rarer changes, observed in patients suffering from syphilis, should be mentioned—(*a.*) Rather sudden decrease in the size of one eyeball, with signs of choroiditis, and with a marked decrease in the number of the retinal vessels. (*b*.) Rapid increase in the size of one or of both eyeballs. (*c*.) Ciliary staphyloma, with glaucoma. (*d*.) Circumscribed cyclitis. (*e*.) Anæmia of the outer half of the optic disk of both eyes after sudden impairment of vision.

Five of the eyeballs belonged to patients suffering from secondary syphilis, and four to persons with inherited syphilis.

Three of the former eyeballs presented the changes observed in ophthalmitis (in two these changes appeared spontaneously, and in one during chancre of the sclerotic and eyelids).

In one eyeball (after repeated attacks of iritis) an attack of choroiditis occurred. This was followed by circumscribed staphyloma of the tunics in front, and beneath the insertion of the superior rectus muscle, with severe pain and loss of vision by glaucoma. In another eye (which was blind, slightly shrunken, and soft, and which was exercised on account of great pain) blood was found in the vitreous chamber, with extensive atrophy of numerous portions of the choroid and retina, as observed after choroiditis "disseminata."

Of the four eyeballs belonging to patients suffering from inherited syphilis, one was removed during an attack of choroido-iritis. The cornea in three was found opaque, and the iris adherent to it (total anterior synechiæ). The synechiæ probably was the result of prolonged contact between the swollen and inflamed iris and cornea.

SYPHILITIC INFLAMMATION OF THE VITREOUS SUBSTANCE.

This inflammation has been observed in one eye alone, as well as in both eyes simultaneously; it can only be recognized with the ophthalmoscope. The optic disk, retina, and choroid appear uniformly hazy throughout.

During the height of the inflammation we find (either on direct ophthalmoscopic examination, or by means of focal light) very minute, numerous, white and opaque dots throughout the vitreous chamber. These dots appear slightly movable during movements of the eyeball. They disappear under proper treatment, and are attributed to a temporary loss of transparency of portions of the vitreous substance.

Patients complain of a mist (coming over the sight rather suddenly), which increases rapidly in density; in order to recognize objects, they are obliged to look for some time. Sometimes the mist becomes "too thick" even to recognize objects.

The sensibility of the retina is impaired throughout, but proportionately from its centre towards its periphery.

The treatment locally consists in the application of atropia (as in iritis); and generally in the use of mercury, of which the bichloride, in doses of $\frac{1}{20}$ or of $\frac{1}{16}$ of a grain, has been found most effectual. The treatment is continued until a good view can be obtained of the optic disk.

Besides the peculiar opacities observed during the inflammation just described, we often meet with opaque threads in the vitreous during, and after, choroiditis, or retinitis. The threads are readily seen with the ophthalmoscope, and also by the patient, if they are close to a sensitive part of the retina. Those which occur in large numbers close behind the crystalline lens are particularly conspicuous, in consequence of their admitting but a small quantity of light into the eye.

SYPHILITIC INFLAMMATION OF THE OPTIC DISK AND OF THE ADJOINING CHOROID AND RETINA.

The centre of the optic disk (at the height of the inflammation) appears pink, the remainder swollen, gray, opaque, and ill-defined. The contours of the optic disk shade off into those of the inflamed choroid and retina, which, in their turn, gradually pass into the healthy retina and choroid. Choroiditis disseminata often occurs simultaneously.

The retinal bloodvessels appear much less numerous; they are thin in the pink central part of the optic disk, and more or less indistinct in the swollen, gray, opaque portions; the veins in the retina are unequally dilated.

In some cases we find extreme anæmia of the optic disk and retina, and one or two thin bloodvessels passing through the swollen optic disk into the retina.

Opaque flocculi in the vitreous adjoining the inflamed parts occur in most cases.

The inflammation at this stage may be mistaken for that observed during albuminuria, or for that which accompanies tumors at the base of the brain. This last kind of inflammation is characterized by the turgid state of the retinal veins in the disk as well as in the retina, and by the swelling being confined to the optic disk. Inflammation of the optic disk during albuminuria is accompanied by brilliant yellowish patches, which appear in the infiltration round the optic disk and in the region of the yellow spot, together with bloodvessels.

Simultaneously with the farther changes in the optic disk, we find the vitreous, retina, and choroid becoming more transparent; portions of the retina may retain a semi-opaque color for years.

Signs of atrophy gradually appear in the choroid, near the optic disk, in the form of pigment spots and transparent patches. This, in young persons, is often accompanied by thinning of the sclerotic, bulging of the tunics, and elongation of the eyeball. The inflammation frequently occurs in both eyes, sometimes with iritis in one or both.

Vision.—At the commencement of the inflammation, patients occasionally complain of intolerance of light, with pain when using the eyes; of fiery stars, etc. (from hyperæmia of the optic nerve); or of a "mist" before the eyes, or of "small" black spots; or of a black web floating before the eyes, obscuring sight in certain directions (caused by opacities in the vitreous close to the retina). These symptoms may disappear rapidly; or may be followed by occasional sudden loss of sight; or by inability to distinguish small or distant objects.

The slightest pressure upon the eyeball is sometimes followed by complete loss of vision for several minutes.

The prognosis, as regards vision, depends much upon the stage of the inflammation at which we undertake the treatment of the case. It is more favorable if lymph and other morbid products have not yet undergone secondary changes, nor induced atrophy.

No improvement of vision has been obtained in those cases in which the optic disk has been anæmic (bluish-white), with atrophic patches in the choroid.

SEROUS IRITIS.

This form of iritis generally occurs in young or middle-aged persons. It appears suddenly, with more or less irregular dilation of the pupil, and with increased tension of the eyeball. The iris at the height of inflammation is highly hyperæmic and discolored, with little or no plastic exudation.

The anterior chamber appears enlarged by increased quantity of more or less turbid aqueous humor. If there is opacity of the cornea, it is either diffused, or assumes the form of minute opaque dots, many of which disappear after escape of the aqueous humor. The ciliary region is unduly vascular, and the tension of the eyeball above par.

The intolerance of light and the flow of tears (of the "non-inflamed eye") also are often great.

Severe pain is complained of in the inflamed eye, and over the corresponding side of the head.

The iritis subsides gradually within about two months; and, owing to morbid changes in the deeper tunics, is often followed by softening and shrinking of the eyeball, with complete loss of vision.

The probable cause of this form of inflammation is the sudden appearance of some foreign substance, such as clots of blood, an entozoon, etc., in the ciliary region, or in some other part of the interior of the eyeball.

Treatment.—Great relief follows the application of from four to six leeches to the skin of the temple next the "inflamed eye," with frequent application of atropia or of lotio belladonnæ to the inflamed eye; or to both eyes, if no amelioration is obtained within 36 hours. No leeches should be ordered if the pain is slight.

No benefit has been derived from general medical treatment, nor from iridectomy, during the height of iritis.

The prognosis is unfavorable, on account of the deep-seated changes which often lead to shrinking of the eye.

SYMPATHETIC IRITIS AND OTHER SYMPATHETIC CHANGES.

A series of morbid changes are termed *sympathetic*, on account of their occasionally appearing in one eye, subsequent to traumatic or spontaneous inflammation of the fellow-eye.

The following, in order of frequency, seem to be the usual causes of such changes:—

(*a.*) Injury to one eye, implicating the ciliary muscle and the ciliary processes; or the presence of a foreign body lodged in the eye, and more particularly in the ciliary region. The injured eye may be inflamed, suppurating, glaucomatous, staphylomatous, or even shrinking, when the sympathetic change appears in the fellow-eye.

(*b.*) Dislocation of the crystalline lens (*e.g.*, depression).

(*c.*) Choroiditis, followed by chalky deposit among the ciliary processes.

These sympathetic changes are tabulated under the following heads, *viz.:* sympathetic irritation, sympathetic inflammation, and sympathetic amblyopia or amaurosis.

One or several of these may appear in the non-injured eye simultaneously with the changes in the injured eye, or at the height of its inflammation, or even long after all apparent morbid action has ceased.

Sympathetic Irritation.—The symptoms are, pain in the ciliary region, often only felt when touching that part; also pain in the forehead of the corresponding side, which is rarely continuous, but always appears when looking steadily at an object. There is increased flow of tears, and undue vascularity of the conjunctiva, especially in the ciliary region.

Vision, as to acuteness, is normal, but there is more or less asthenopia.

Removal of the injured eye, as a rule, arrests the sympathetic irritation of the fellow-eye immediately, or within a few days.

The patient, as long as the injured eye or the cause of the sympathetic irritation has not been removed, must thoroughly rest the eyes; out of doors wear a shade, and spectacles with tinted glasses, and use atropia twice daily to both eyes.

Sympathetic Inflammation.—The inflammation, in most cases, commences with what is termed sympathetic iritis, and in many it goes on the chronic ophthalmitis.

SYMPATHETIC IRITIS.

Sympathetic iritis is a peculiar, and fortunately rare, form of iritis.

It has been observed after concussion of the eyeball, and after some foreign substance has become lodged in one eye. It appears first in the injured eye, and soon after affects the sound one; or the injured eye may have become destroyed at the time when the iritis sets in the fellow-eye.

The iritis commences without pain, with moderate intolerance of light, and slight undue vascularity of the sclerotic. It thus escapes notice on the part of the patient; and if confined to one eye, may, together with the deep-seated changes, have already caused shrinking of the eyeball before it attracts attention.

At first there is slightly increased tension of the eyeball; this is gradually followed by normal decrease of tension. The aqueous humor is somewhat turbid, the pupil fixed and contracted, or of medium size, with often total posterior synechiæ.

The iris is swollen, discolored, and crowded with large varicose bloodvessels; sometimes in such numbers that its texture seems changed into a close network of enlarged vessels.

There is slight sclerotic redness, and some enlargement of the ciliary veins.

It must be borne in mind that in most cases the choroid and vitreous substance become similarly affected. (See *Sympathetic Ophthalmitis.*)

When examining the uninjured eye with the ophthalmoscope, before any iritis is perceptible and while vision is still acute, we find the optic disk pink; some diminution in the width of the retinal arteries, along with enlargement and varicosity of the retinal veins. We may still be able to view the retina, etc., after iritis has set in; we then find (if the iritis has existed from four to six weeks) the optic disk pink, ill-defined, the retinal vessels few and thin, and only traceable a short distance into the retina. The latter, together with the choroid, has a uniform hazy, dirty-red color.

Vision gradually becomes misty, and is in many cases lost in both eyes. The eyeballs become reduced to small, soft "stumps."

Treatment.—Medical treatment has hitherto been found useless. The removal of the injured eye should be urged at once, if vision is destroyed, or if symptoms of sympathetic inflammation appear in the other eye, though vision of the injured eye may not be quite lost. Excision of the injured eye should likewise be recommended if the symptoms of sympathetic irritation do not subside on proper treatment; such as the application of warm fomentations,—the frequent application of atropia,—the wearing, when out of doors, of spectacles with tinted glasses,—and confinement in a darkened room when at home, as long as there is the slightest intolerance of light,—with complete rest of the eyes for months after all vascularity has disappeared.

In three patients under Dr. Walker's care within two years, in which the varicose state of the vessels of the iris existed already in both eyes, useful vision and normal tension were restored to both eyeballs, by performing iridectomy, with removal of some of the ciliary processes adjoining the excised iris; and by subsequently removing the crystalline lens, which previously had been rendered opaque.

This treatment was adopted upon the supposition that the crystalline lens acted as a foreign body; and with the wish to interrupt the circle of infiltrated ciliary processes.

The excision of the injured eye, though there be no sign of disturbance in the sound one at the time of the operation, unfortunately does not exclude the subsequent occurrence of the sympathetic inflammation.

Sympathetic Ophthalmitis.—If, as happens frequently, the changes observed in sympathetic iritis occur simultaneously in the choroid, and in the parts adjoining it, then the inflammation is termed sympathetic ophthalmitis.

This differs from common suppurative ophthalmitis by the chemosis, the swelling of the eyelids, and the pain being but slight, and by there being no abscess within the eye.

In sympathetic ophthalmitis we find the tunics, especially the choroid, retina, and the vitreous substance, saturated with a nearly transparent, highly coagulable substance, termed by some fibrinous infiltration. At first there is slight swelling of the parts in which the substance appears; this is followed, in the majority of cases, by more or less shrinking of the eyeball. A section of an eyeball thus inflamed very much presents, at one stage, an appearance as if all the parts within the sclerotic were occupied by semi-opaque cancerous growth. The infiltration is so uniform that the boundary between sclerotic, choroid, retina, and vitreous cannot be traced, or only with difficulty. The semi-transparent "infiltration" gradually changes into opaque tissue. A section made of such an irregularly-shrunken eyeball shows the parts within the sclerotic changed into a mass of bluish-white, and opaque, dense, fibrous tissue.

Shrunken eyeballs, when resulting from concussion, or foreign bodies lodged within the eye, are apt to become inflamed or painful, especially in persons advanced in life; while eyeballs lost by sympathetic ophthalmitis remain quiet.

The treatment of this form of ophthalmitis is the same as that of sympathetic iritis.

Sympathetic Amaurosis, or Amblyopia.—The exterior of the affected eye generally presents no morbid changes, except impaired mobility of the pupil; whereas, examination with the ophthalmoscope shows more or less anæmia of the retina and optic disk, with varying degrees of atrophy. These changes, in some cases, may be the result of chronic choroiditis.

The anæmia often appears first in the part of the optic disk nearest the yellow spot, and thence extends. Vision may remain "good" for months, or even years after the injury to the fellow-eye, before it begins to fail "gradually".

Only in a few cases has some benefit been derived from the alternate use of strychnia and bichloride of mercury.

CYCLITIS, OR INFLAMMATION OF THE CILIARY REGION OF THE CHOROID.

There are probably as many forms of cyclitis as of iritis. Dissections of eyes, exercised from the living, and observation on the fellow-eyes, to those exercised (which have suffered from a minor degree of the same form of inflammation), have assisted in establishing the existence of a *simple or plastic cyclitis, and a syphilitic cyclitis.*

Plastic Cyclitis.—Plastic cyclitis frequently occurs after injuries (foreign bodies lodged in the eye, dislocation, swelling, etc., of the crystalline lens, depression of cataract).

The cyclitis is the usual complication, and often the cause of severe iritis or choroido-iritis; it is the cause of the chronicity of their course. Cyclitis often causes permanent impairment or loss of vision. The choroid in the ciliary region is destroyed, or is impeded in its functions by more or less thick and extensive, gray and opaque, fibrous substance, which intervenes between it and the crystalline lens and vitreous chamber. The nutrition of the vitreous substance and of other structures suffers. The eyeball becomes softer, the cornea opaque and smaller, the pupil closed. The tunics of the ciliary region gradually shrink, though the retina may continue sensitive for a long time. The retina frequently becomes drawn away from the choroid during contraction of the altered vitreous substance.

When using the term "fibrous substance" for the opaque texture found after cyclitis adhering to the inner surface of the ciliary processes and to the hyaloid fossa, it must be understood that this substance consists of "organized" portions of a plastic "effusion" mixed up with the structure of the ciliary processes, vitreous substance, etc.

Symptoms.—Pain, when touching that part of the sclerotic which corresponds to the "inflamed" portion of the ciliary processes, etc., is the most constant symptom of this form of cyclitis. The pain may be extreme and continuous in the eye; and in the head there may be none. It is attributed to displacement of and pressure upon the ciliary nerves.

More or less severe sclerotic and subconjunctival vascularity along the margin of the cornea, with enlargement and tortuosity of the veins of the iris, choroid, and retina. This having existed for some days, hypopyon may appear and disappear repeatedly. At the same time yellowish and opaque shreds become visible behind the crystalline lens in the vitreous chamber. These and the hypopyon, if there is no corneitis or iritis, are characteristic of cyclitis.

The hypopyon may be present, or cause cornea-iritis; whilst the "vitreous opacities" are always found. The opacities may disappear in from four to six weeks; while gray and opaque, fibrous and chalky spots make their appearance among and upon the ciliary processes and the hyaloid fossa, together with the changes which follow inflammation of the tunics.

Whether, subsequent to cyclitis, the eye shrinks or remains softer; or, having been so, resumes its normal tension, depends—

(1.) Upon the severity of the cyclitis.

The more of the ciliary region of the choroid is destroyed, or the thicker the fibrous substance is upon and among the ciliary processes and in the hyaloid fossa, the less favorable is the result.

(2.) Upon the state of health.

The same degree of cyclitis which in a poor, ill-fed person leads to shrinking of the eye, may in a strong patient end in recovery of useful vision.

(3.) Upon the cause.

Foreign substances in the eye—a piece of metal, a dislocated lens—may become a continuous source of irritation, and of repeated attacks of cyclitis.

Vision.—On account of frequent complications with cornea-iritis or choroido-iritis, it is difficult to determine the share which cyclitis takes in the impairment of vision. The opacities in the vitreous chamber give rise to the complaint of a "mist" intervening between the eyes and the object looked at.

The usual cause of loss of vision is displacement, or atrophy of the retina, or both.

Treatment.—*The treatment* of cyclitis is the same as that of simple iritis. Leeches (from four to eight) are applied at bed-time if the pain is great. Applications of iced water should be tried at first, and continued as long as cold is pleasant.

The fellow-eye must be kept at rest, and under the influence of atropia, if any sympathetic irritation exists.

Excision of the inflamed eye is performed if a "foreign body," *e.g.*, a dislocated crystalline lens, is within the eye (attempts to extract it having failed), or if the shrinking blind eye is very painful.

Syphilitic Cyclitis.—This form of cyclitis is a sign of severe syphilitic inflammation: it is not unfrequent, and often occurs in both eyes.

Lymph sometimes not only appears among the ciliary processes, but also in the sclerotic along the margin of the cornea, cornea-iritis, and choroido-iritis, occur simultaneously.

The cyclitis is observed in inherited as well as in secondary syphilis; in both, though especially in the former, it gives rise to staphyloma of the sclerotic, to thinning of the structures of the ciliary region, and to the peculiar sugar-loaf shape of the eyeball, with or without staphyloma.

Its effects upon the nutrition of the tunics are similar to those of simple cyclitis, though better recoveries are observed in the syphilitic form. Cases of shrinking of the eye with loss of vision, unfortunately, often occur. (For treatment, see *Syphilitic Iritis and Staphyloma.*)

HYPERÆMIA OF THE CHOROID.

Hyperæmia of the choroid gives rise to a sensation of fulness in the eye, and to slight lachrymation and intolerance of light, with pain in the eye.

When comparing the hyperæmic choroid with that of the healthy eye, *e.g.*, in myopic persons (who are frequently subject to it), we observe an increase of "redness," with unusual fulness and a tortuous course of the retinal veins over and near the hyperæmic portion.

INFLAMMATION OF THE CHOROID. CHOROIDITIS.

The general remarks which were made upon iritis apply equally to choroiditis.

Certain symptoms are common to all forms of choroiditis; these are:—loss of transparency of the choroid and atrophic changes.

Others are peculiar to different forms; from these special names are derived.

Lymph-nodules are observed in the syphilitic; large gray, or yellow and opaque patches, in the plastic—a "turbid" red color of the choroid, and increased tension and dilation of the pupil in the serous forms of choroiditis.

Choroiditis can, to insure accuracy of diagnosis, only be recognized with the ophthalmoscope. External and objective symptoms may be absent altogether. Pain, intolerance of light, impairment of vision, fulness of the veins emerging from the sclerotic in the ciliary region, sclerotic redness, a sluggish pupil, etc., are symptoms frequently observed, but not characteristic of any of the forms of choroiditis.

Ophthalmoscopic observations show that, as regards duration, choroiditis differs little from similar forms of iritis, unless implication of other tunics be a source of prolonged disturbance.

The state of vision varies according to the seat, extent, and severity of the inflammation, and according to its effect upon the retina or optic disk.

Small inflamed spots, implicating the retina at the yellow spot, give rise to complaints of disturbed vision; whilst large portions of choroid, near peripheral parts of the retina, though the retina be perhaps more extensively affected, may run through all stages of inflammation, and neither disturb vision nor give rise to other complaints.

Solitary portions of choroid, when impairing the functions of corresponding parts of the retina, give rise to loss or impairment of the functions of these parts. These may be paralyzed, completely destroyed, or merely reduced to perception of light.

A gradual transition from less sensitive to normal parts of retina is the rule in circumscribed choroiditis.

The prognosis, as regards recovery of inflamed parts of the choroid, is more favorable if no atrophic patches are perceptible.

As regards vision, it is less favorable if the inflammation is at or near the region of the yellow spot, and if the retina over the inflamed part is quite paralyzed.

The "exudation," seen with the ophthalmoscope, appears generally of a gray, or yellowish, rarely of a brown and opaque color; it assumes the shape of roundish spots, or of large patches surrounded by vascular ("red") choroid. Only one large portion of choroid, or one or numerous small isolated spots, and in severe cases the entire choroid, may be occupied by "infiltration."

Among the changes which are peculiar to choroiditis, and which are observed with the ophthalmoscope, we must distinguish those which are produced by the "exudation," those which are the result of hyperæmia or of atrophy of the choroid, and those which are situated in the retina, or optic disk, or vitreous chamber.

Round the choroidal aperture, and in the region of the yellow spot, the infiltration frequently appears in the shape of roundish spots and patches. These gradually disappear; and the changes of atrophy, etc., are observed in and round the portion of choroid which they occupy.

Minute examination has shown, that in the portion of choroid occupied by the infiltration, the bloodvessels are obliterated, partly by exudation, and partly by changes in the contents of the vessels themselves. The transparency of the retina, over and near the focus of inflammation, is impaired in most cases. The grayish, hazy retina merges gradually into transparent portions. The vessels may be lost sight of in the hazy portions of retina, or may appear varicose and enlarged. Blood-spots occasionally appear from rupture of small vessels.

CHOROIDITIS AT OR NEAR THE OPTIC DISK.

The inflamed portions of choroid are readily recognized by the outlines of the optic disk appearing ill-defined. The optic disk may become as red as the choroid; and often can hardly be recognized but for the enlarged retinal veins meeting in it. The disk, in other cases, appears anæmic in the middle, and very congested next the choroid; or part or the whole of the disk may be occupied by "exudation." The appearance of the disk varies according to the stage of the inflammation. Destruction of the optic nerve-fibres by choroiditis at the choroidal aperture (in one or both eyes) is not an uncommon occurrence.

Opacities in the vitreous chamber, near the seat of choroiditis, are usually present; and are often the only symptoms noticed by the patient, who, if these opacities are close to a sensitive portion of retina, complains of black spots, clouds, etc., floating before the eyes.

Iris, and hyperæmia of the iris, are frequent complications. (See *Syphilitic Choroiditis and Inflammation of the Optic Disk.*)

Treatment.—The treatment of the different forms is the same as that of corresponding forms of iritis.

If mercury is given with a view of producing salivation within a few days, it is best to employ frications with mercurial ointment (from one to three drachms to be rubbed into the armpits, twice daily).

No treatment seems of use when atrophic spots have become visible in the choroid.

ATROPHY OF THE CHOROID.

The atrophic portions of choroid, viewed with the ophthalmoscope, are conspicuous by their contrast with the parts adjoining them.

Transparent portions represent the highest degree of atrophy. In these the pigment and blood have disappeared, and only a thin, transparent membrane is left. These portions, in the living, appear as brilliant white patches, spots, etc.; the white color being caused by the sclerotic, which subtends the transparent and atrophic choroid, and from which the light is reflected. These transparent portions, as a rule, are surrounded by pigment spots. These and the transparent spots are found side by side.

Atrophic portions of choroid often skirt the optic disk, in the form of crescents in the myopic eye; they are observed as small, well-defined, brilliant white and brown or black spots in other portions of choroid, after various forms of choroiditis, etc.

Pigment spots caused by groups of stellate pigment cells cannot be mistaken for those due to alteration of the hexagonal cells and of their granules; since the shape of the former, in different parts of the choroid, is sufficiently characteristic. Alterations in color of groups of stellate pigment cells (from a light to a dark-brown, and *vice versa*), or a diminution of tint (from light-brown to pale-yellow, or to complete transparency), are observed in prolonged anæmia of the choroid, and especially in atrophy and in staphyloma. In health, we find that the darker the iris, the deeper is the tint of the choroid.

Every inflammation is accompanied by pigment changes. The pigment granules of the hexagonal cells, over and near the seat of inflammation, become too transparent or too much tinted. They decrease in number, or are destroyed, or they become displaced and accumulated round the foci of inflammation. Hence the groups of circles, or spots of deep-brown and black pigment which skirt transparent atrophic parts of choroid, or which are scattered over more or less anæmic portions.

Pigment spots are the results of changes in the hexagonal cells, or in the stellate pigment cells; and may assist in localizing morbid changes of the retina or choroid.

The choroid, which undergoes atrophy, may appear light-red before it becomes transparent.

If there is staphyloma at the same time, we find at its margin the large choroidal vessels unusually broad and farther apart from each other; and also the vessels of the retina deviating from their normal course.

The choroid, retina, and sclerotic are adherent to each other at the transparent atrophic spots, and frequently also at the pigment spots.

DISPLACEMENT OF THE CHOROID.

Displacement of the choroid has been observed in the course of cancer and other tumors, and also after effusion of transparent fluid or of blood between the choroid and sclerotic.

The displacement has been observed in young persons suffering from irregularities incident to menstruation; frequently in glaucomatous eyes, but rarely after injury.

The equatorial region of the eye is the usual seat of the displacement; though, in several cases, it has occurred at the yellow spot.

Viewed with the ophthalmoscope, the displaced portion appears as a dark-brown, sharply-defined, roundish patch, with semi-transparent retina over it, and surrounded by the natural color of choroid and retina. In those cases in which large portions had become detached, no light reached the sclerotic, and all appeared dark behind the clear crystalline lens. The eye should not be lighted up with the ophthalmoscope. In some cases this condition was marked by displacement of the retina. Sudden impairment of vision, to correspond to the displaced portion of choroid, was observed in some cases.

Decrease of tension with gradual shrinking of the eye occurred in some cases; whereas in others the blood became absorbed; and this was followed by circumscribed atrophy of the choroid, with loss of vision from atrophy of the retina.

ATROPIA AND CALABAR.

Among medical agents which are employed to act upon the iris we distinguish *mydriatics*, or remedies which cause dilation of the pupil and paralysis of the power of accommodation; and myotics, which increase that power, *i.e.*, the contraction of the ciliary muscle, and which cause contraction of the pupil. Of mydriatics the preparations of atropia belladonna (solanea) are in general use. As myotics are used the preparations obtained from physistigma venenosum (leguminosæ).

The Sulphate of Atropia.—Wherever the term atropia is used the solution of sulphate of atropia (¼ of a grain of the sulphate of atropia to ℥j. of distilled water) is to be understood.

Atropia or "atropine" is supposed to act as an excitant of the ganglion cells and the fibres of the sympathetic nerve. A solution of the sulphate of atropia, brought into contact with the conjunctiva, passes through the cornea, mixes with the aqueous humor, and produces dilation of the pupil. Such aqueous humor, applied to another person's conjunctiva or cornea, again produces dilation of the pupil.

Profuse "watering of the eye," morbid changes of the cornea, and great increase in tension of the eyeball, may prevent the atropia from reaching the iris.

The pupil of a healthy eye becomes dilated to its maximum (*i.e.*, its sphincter is paralyzed and its dilator strongly contracted) in from fifteen to thirty minutes after applying to the conjunctiva a solution of the sulphate of atropia (atropiæ sulphatis, gr. ¼; aquæ distillatæ, ʒj.). Soon after this the ciliary muscle, and with it the power of accommodation, becomes paralyzed. Within about three hours after application its effects can, with the ophthalmoscope, be perceived in the retina and choroid; in these it causes dilation of the bloodvessels. It also affects the action of the external muscles of the eye. Its effect continues for several days after one application. By paralyzing the ciliary muscle, it is supposed to contribute towards diminution of the tension of the eyeball.

The stimulus of light, efforts of accommodation, etc., sometimes act injuriously when the bloodvessels of the interior of the eye are dilated with atropia.

Atropia reaches the throat by passing through the lachrymal passages; and, if frequently applied, may, especially in children, cause symptoms of poising. Such symptoms are increased rapidity of the pulse, *e.g.*, 110 pulsations instead of 70, with dryness of the throat and restlessness, followed by sleep with much dreaming. Graver symptoms are general excitement, with hallucinations ("strange figures and objects seeming to move about on the bed") and inability to swallow. In cases of iritis of one eye only, and in cases of spasm of the ciliary muscle, symptoms of poising may appear before any local effect upon the iris or accommodation is produced. Our attention should be directed to the above symptoms if prolonged application of atropia is required.

The best antidote, if the graver symptoms present themselves, is the subcutaneous injection of the acetate of morphia, which produces its effects in from ten to twenty minutes after injection.

The sulphate of atropia is prescribed in the form of—(1.) *Drops* of varying strength (guttæ atropiæ). Two kinds are in general use:—(*a.*) ℞. Atropiæ Sulphatis, gr. ¼; ad Aquæ Distillatæ, ℥j. Misce (to be used in inflammatory changes, corneitis, iritis, etc.). (*b.*) ℞. Atropiæ Sulphatis, gr. ij.; Aquæ Distillatæ, ℥j. Misce (to be used to bring on rapid paralysis of the power of accommodation).

The effect of the atropia is best secured by giving directions "to take a camel's-hair brush or the fan of a quill, to dip it into the lotion, then gently to draw the lower lid away from the eye, and to touch the inner surface lightly with the brush. The mere touching of the conjunctiva with the brush suffices. The sulphate of atropia should be pure, and contain no resinous substances: it should cause no irritation. One part of the sulphate of atropia to two thousand parts of distilled water is sufficient to dilate the pupil.

If, for ophthalmoscopic purposes, we wish to dilate without impairing the accommodation too much, we may use a lotion made of one part of atropia to one hundred and twenty parts of water.

If the drops are used frequently or for a considerable time (in some patients even after one application), increased redness of the conjunctiva with chemosis and muco-purulent discharge, with swelling of the eyelids, and sometimes erysipelas on that side of the face, may appear. This form of inflammation caused by atropia is termed *atropinism*. The atropia must, in such cases, be discontinued for a few days, and some astringent lotion (of acetate of lead, or alum) be used. In such cases, instead of using the drops, we apply the atropia gelatine.

(2.) *Unguentum Atropiæ.*—℞. Atropiæ Sulphatis, gr. j.; Unguenti Spermaceti, ʒij. Misce.

(3.) Endermatic application of atropia.

A blister is raised over the spot beneath which lies the nerve which we wish to act upon by atropia. The skin of the blister being removed, from $\frac{1}{12}$ to $\frac{1}{4}$ of a grain of the powdered sulphate of atropia is sprinkled over the raw surface.

(4.) Subcutaneous injection of atropia.

An injection of $\frac{1}{60}$ of a grain of the sulphate of atropia produces acceleration of the pulse. As much as $\frac{1}{12}$ of a grain has been injected at one time.

(5.) Atropia gelatine.

The pieces of atropia gelatine supplied by Messrs. Allen & Hanbury, of Plough Court, Lombard Street, E. C., London, are divided into little squares. Each square contains (according to an examination made by Mr. Daniel Hanbury) somewhat more than $\frac{1}{1000}$ of a grain of the sulphate of atropia.

When brought into contact with the conjunctiva the atropia gelatine becomes rapidly dissolved; it does not, like atropia paper, act as a foreign body.

Physotigma Venenosum.—The fruit of this plant is a bean, termed the Calabar bean. (Wherever the term "Calabar" is used a preparation of the Calabar bean is to be understood.)

The alcoholic extract of the bean, known as the extract of "Calabar bean," and the Calabar gelatine are the preparations generally used.

Calabar, when brought into contact with the conjunctiva, causes lachrymation, and, in about five minutes later, contraction of the pupil, followed by contraction of the ciliary muscle. This contraction reaches its height in half an hour, and continues for about twelve hours, without, however, producing complete immobility of the pupil.

Calabar counteracts the effect of atropia, and also acts if there is paralysis of the pupil. The contraction of the pupil and ciliary muscle, thus produced, generally causes pain, which may be very severe, and continued for hours. The pain increases if the eye is used, *i.e.*, if efforts at accommodation are made. Slight efforts at accommodation produce much more contraction of the ciliary muscle if a weak solution of the Calabar has been applied, than if the same efforts are made under ordinary circumstances.

Patients, if directed to apply the Calabar themselves, should use small squares of Calabar gelatine (as prepared by Allen & Hanbury), which contain a known quantity of the active principle of the bean.

An examination of Calabar gelatine (made by Mr. Daniel Hanbury) shows that "500 of the little squares weigh 9.75 grains, say in round numbers 10 grains. This allows for one square a weight of .02 grain, or $\frac{1}{50}$ of a grain. Then, as the gelatine contains *one-sixth* of its weight of extract of Calabar bean, a little square, which weighs .02 grain, will contain of it (the extract) .0033 grain (=$\frac{1}{300}$ of a grain)."

A square of the Calabar gelatine placed on the conjunctiva of the lower lid readily dissolves. Its local effect ceases in from twelve to twenty-four hours. Atropia applied to one eye and "Calabar" to the other produce their specific effects; and do not interfere with each other's action.

Calabar taken internally depresses the functions of the spinal cord, and thus prevents the transmission of nervous impulses through the cord, to and from the iris.

Calabar is by some looked upon as a respiratory poison, causing asphyxia; by others as interfering with the contraction of the heart, and producing syncope.

GLAUCOMA.

Formerly the term glaucoma was applied to the last stage of the disease only, *viz.:* that in which the pupil had become fixed, irregular, and dilated, its area greenish, the ciliary vessels enlarged, the eyeball of strong hardness, and vision lost, etc. With our improved means of diagnosis we can discover the signs of glaucoma in persons with apparently perfect sight.

The term glaucoma is at present applied to a series of morbid changes of the eyeball; the most prominent of which, and, apparently, the one which causes nearly all the others, is an increase in the tension of the eyeball.

This increase of tension, or, in other words, the abnormal resistance of the tunics of the eyeball to the touch, is attributed to an increased amount of, and to changes in the contents of the vitreous chamber, which give rise to disturbances in the circulation, nutrition, and functions of the textures of the eyeball. No satisfactory explanation can as yet be given of the primary cause of the increased tension; whereas most of the subsequent changes in the textures of the dyeball are readily explained by reference to it. These changes, in the majority of cases, are accelerated by attacks of inflammation; which either appear suddenly with remissions, or as chronic inflammation with slight exacerbations. These attacks of inflammation themselves are symptoms of disturbed tension.

Their occurrence, succession, and rapidity seem to depend, in a great measure, upon the power which the eye possesses of adapting its nutrition and circulation to the disturbance occasioned by the increased tension.

Glaucoma, when appearing without attacks of inflammation, is termed *simple glaucoma.* The increase of tension, and the changes resulting from it, appear gradually, and proceed without any external inflammation. If attacks of inflammation accompany the glaucomatous state of the eye, it is termed *chronic or acute inflammation.*

Chronic glaucoma, or, rather, glaucoma with slight attacks of inflammation, is the most frequent form. The attacks of inflammation occur at first at long intervals, are slight, and not well marked.

In acute glaucoma, or, rather, glaucoma with acute inflammation, the latter is severe in character and sudden on its onset.

Simple or chronic glaucoma may appear in one eye, and acute glaucoma in the other. An acute attack of inflammation may occur in an eye with chronic glaucoma; and *vice versa*, *e.g.*, an eye suffering from acute glaucoma may, after the attack has subsided, assume the aspect of chronic glaucoma. The gradual and often hardly perceptible progress of the glaucomatous changes, with only slight attacks of inflammation, and with little or no pain, finally produce the same well-marked glaucomatous aspect of the eye, as an acute attack of inflammation does in a short time.

To be able to recognize glaucoma in its different forms and stages, we must be familiar with the normal tension of the eyeball (see *Tension of the Eyeball*), and with the glaucomatous symptoms peculiar to the different textures of the eye.

Glaucomatous symptoms, *i.e.*, such as are occasioned by an increase of tension in the eyeball, have been mentioned when speaking of other morbid changes of the eyeball (as cataract, corneitis, iritis, and myopia). Here again we find that a thorough acquaintance with the alterations of the tension of the eyeball, as well as the recognition of symptoms and changes depending upon it, are of the greatest service in the treatment of these morbid changes.

The progress of glaucoma, in the majority of cases, is accompanied at one period by attacks of inflammation. These attacks attract the patient's attention, particularly on account of their generally being accompanied by impairment of vision, and pain.

They vary as regards severity, frequency, and rapidity of appearance.

If severe and sudden, they are termed acute. An attack may pass off, and some time intervene between it and a fresh one. The interval between the attacks becomes, as a rule, shorter in the later stages of glaucoma. Often a severe attack follows several slight and rapidly succeeding ones.

An acute attack, however, often appears without other symptoms having attracted the patient's attention. Cases have occurred in which vision has been lost suddenly, a few days previous to the appearance of the acute inflammation.

Acute inflammation has been observed in glaucomatous eyes which had been blind for years, and in eyes the sight of which had been lost by cerebral amaurosis.

A patient suffering from an attack of glaucoma with acute inflammation generally states, that he was seized with sudden severe pain in the eye (frequently while in bed, or after having passed some sleepless nights, or after having been subject to excitement). He describes the pain as extending over the corresponding side of the head, and more especially over the forehead and temple; and says, that on closing the other eye he has found that with the painful eye he cannot see, or, at best, but very imperfectly.

Should the patient be seen the same day, or one or two days after the attack, we generally find the eyelids slightly reddened and swollen along their margins; the conjunctiva somewhat chemotic, with its bloodvessels, and those of the sclerotic, numerous and enlarged; profuse flow of tears, and often much intolerance of light; and the aqueous humor turbid.

The pupil is more or less dilated, often immovable and irregular; vision much impaired, sometimes reduced to bare perception of light; the pain is severe in the eyeball and over the forehead and temple; the tension of the eyeball is increased.

The changes observed with the ophthalmoscope are stated below, together with other glaucomatous changes of the textures of the eye.

The acute inflammation, after a few days or weeks, passes off spontaneously, although gradually, unless it be treated properly.

The functions and structures of the eye remain more or less altered. Similar acute attacks may appear repeatedly; but more frequently the eye assumes the character of "chronic glaucoma."

The symptom which most distresses the patient, when suffering from glaucoma with slight attacks of inflammation ("chronic glaucoma"), is the temporary "dimness" of vision. On inquiry, we generally find that these "attacks of dimness" coincide with those of slight inflammation. The symptoms of the latter are —more or less pain in and round the eyeball, with increase of the already abnormal tension; undue vascularity of the conjunctiva and of the sclerotic along the margin of the cornea; slight turbidity of the aqueous humor; and sluggishness of the movements of the iris.

The course of simple glaucoma is still less striking than that of chronic glaucoma. Attacks of inflammation, acute or chronic, may appear during any part of the course, sometimes only after vision is destroyed.

To recognize glaucoma in its simple form, we must be familiar with the use of the ophthalmoscope, and with the mode of ascertaining the tension of the eye.

Simple glaucoma is often mistaken for cerebral amaurosis.

Vision becomes impaired gradually, the power of accommodation lost, and the pupil sluggish, and more or less dilated. The increase of tension, and mode of impairment of vision, the alteration of the optic disk and of the retina, when seen with the ophthalmoscope, are in themselves sufficiently characteristic to prevent our mistaking this or any other form of glaucoma.

The glaucomatous symptoms, as exhibited by the various structures of the eye, require a more detailed description.

The increase of tension of the eyeball is, as far as is known, the earliest perceptible symptom of glaucoma; it may precede most of the others for some years.

The tension, though remaining above par, varies in degree at different periods; and likewise varies in its effects upon the different structures. A retina, for instance, may have become completely paralyzed by pressure, while the sensibility of the cornea and the shape of the pupil, etc., are but little altered.

The tension increases suddenly during an acute attack of inflammation.

The hardness of the glaucomatous eyeball reaches its height soon after vision is lost, and continues for a long period.

As one of the later and rarer changes in the blind glaucomatous eye, must be mentioned a fluid condition of the vitreous substance, with dislocation of the chalky crystalline lens, and a decrease of tension to T—2. The tension of the glaucomatous eye, after removal from the orbit, sinks below par in some instances; in others it remains unaltered.

In many cases the tension is reduced to the normal degree soon after iridectomy, and, at a later period, it may sink below par.

In another series of cases the tension remains a little above par after iridectomy; whereas in glaucoma, complicated with attacks of profuse hemorrhage into the vitreous chamber, it often is not altered at all, or only at a late period.

The same has been observed when, in young persons suffering from glaucoma, the iris has been much pushed forwards, previous to the operation.

If a well-performed iridectomy does not reduce the tension, a second operation should be tried: this sometimes succeeds in controlling the tension.

The Eyeball becomes more Globular in Shape.—Alterations in curvature of the cornea, staphylomatous portions behind and at the side of the insertion of the recti muscles, and in the equatorial region, and beneath the insertion of the oblique muscles, often occur in later stages of the disease.

Staphylomata decrease much, and sometimes disappear of successful iridectomy.

The conjunctiva in simple, and in chronic glaucoma is remarkable for its rotten condition. Together with the subconjunctival tissue it becomes atrophic, and readily tears, when seized, so as often to be quite useless for fixing, or rotating the eye during operation.

It becomes chemotic and vascular in "acute glaucoma."

The sclerotic, in acute glaucoma, appears slightly reddened.

The ciliary vessels, which emerge from the interior of the eye through the sclerotic, especially in front of the insertion of the recti muscles, are large, tortuous, and numerous in most cases of chronic glaucoma, although they often become smaller, or disappear entirely in the later stages, or after successful treatment.

The cornea gradually becomes anæsthetic. The anæsthesia, at first, may be confined to certain parts; but it disappears if the tension is relieved in time.

In the later stages the shape of the cornea often suffers; some parts (the more paralyzed ones) becoming staphylomatous. Softening of the cornea, and chiefly of its central portion, advancing from the surface inwards, has been observed.

The cornea may become more or less opaque. Sometimes a crescentic ulcer or diffused purulent infiltration occurs; which may be followed by perforation, intraocular hemorrhage, and shrinking of the eye.

The latter result may also follow when the suppuration spreads from the cornea into the eye.

The Aqueous Humor and its Chambers.—The anterior chamber appears smaller through the iris and crystalline lens approaching the cornea—in some instances to such a degree as to touch the cornea in certain places. The quantity of the aqueous humor is diminished. These changes in the aqueous chambers may be missing in any form of glaucoma; they have also been observed in young glaucomatous persons.

The diminution in the size of the aqueous chamber occurs slowly in chronic and often quickly in acute glaucoma.

It is a favorable symptom if the size of the chamber increases after iridectomy.

Attacks of inflammation cause the aqueous humor to appear turbid; this turbidity may disappear after a few minutes, or it may appear and disappear several times in the course of the day.

Spontaneous hemorrhage from the vessels of the iris in the aqueous humor is a frequent occurrence. The *iris* gradually loses its mobility, partly through pressure upon the ciliary nerves, partly through atrophic changes.

The iris hardly ever returns to the normal condition, though an iridectomy may otherwise have been successful. It has been observed, that if only part of the cornea has lost its sensibility, the corresponding portion of iris has alone been paralyzed.

In acute glaucoma the mobility of the iris may become arrested at once, whereas in simple and chronic glaucoma this occurs slowly.

The color of the iris appears altered, according to the stage of the glaucoma—the dilation of the bloodvessels—the complication with iritis—and the state of the aqueous humor.

Enlarged bloodvessels are often seen with the naked eye in the iris, especially in simple glaucoma. The iris, at last, becomes atrophic, and assumes a slate color; and its rotten condition renders removal by iridectomy very difficult.

The *pupil* is, in many cases, at first unusually contracted. Its movements gradually become sluggish, and generally somewhat irregular. In the latter stages of glaucoma, unless prevented by adhesions, it becomes widely dilated and motionless. Cases of simple glaucoma often occur in which the pupil, though immovable, retains a medium size.

In the choroid we observe—(1.) Hemorrhage (? from impeded return of blood). (2.) Anæmic spots. (3.) Atrophy, extending (as in the retina) from the ora serrata backwards. (4.) Staphylomatous changes in the atrophic parts.

The hemorrhage frequently occurs in the equatorial region, and in the region of the yellow spot. The blood is accumulated in the outer layers of the choroid, and between the latter and the sclerotic.

These blood-spots, when viewed with the ophthalmoscope, appear as black or brown, roundish, ill-defined patches, surrounded by the neutral red reflection from the choroid; not unfrequently they are situated close to atrophic portions.

Only after operations (iridectomy, extraction of cataract, etc.) has the hemorrhage been so great as to separate the choroid nearly completely from the sclerotic.

The anæmic spots, as seen with the ophthalmoscope, appear roundish, white, well-defined, and in groups. They are mostly in the region of the yellow spot, and near the optic disk.

The staphylomatous atrophic portions of choroid (and other tunics) are usually found in front of the equator, between it and the ora serrata, and, by preference, behind the insertion of the muscles. Viewed with the ophthalmoscope, they have a pale-red color; which is the more marked, the greater the atrophy of the choroid. This form of atrophy differs from other forms, on account of the frequent absence of pigmented patches round the atrophic portions.

Microscopic examination of the choroid, in chronic glaucoma, shows the large veins and the capillaries gorged with blood, and much dilated.

The stellate pigment appears normal round the optic disk, as well as in most other parts of the posterior half of the choroid. From the equatorial region to the ora serrata, it is thin and atrophic in some, and completely missing in other places. The hexagonal cells, round the optic disk, appear normal, or nearly so, as regards size, shape, and pigmentation. They are more altered nearer the ora serrata. Upon the atrophic parts of the choroid they are missing; near these parts they appear rugged in some, and round, and unusually large, in other places. Some are filled with pigment granules, whilst others contain but few, or are entirely empty; many of the granules themselves appear abnormally large. Colloid globes or globules, disarranging the regularity of the cells, are found in a few cases only.

The changes in the bloodvessels and in the pigmentation are, in all cases, most conspicuous from the equatorial region to the ora serrata. The texture of the choroid is rotten.

The *crystalline lens*, in the later stages of glaucoma, assumes, as a rule, a greenish tint; which, however, is not characteristic of glaucoma.

Light, reflected from the hyaloid fossa, returns through the crystalline lens, and mixes with the slightly bluish-gray light; which is reflected from the anterior surface of the capsule, and from the portions of the lens adjoining it. The greenish tint disappears from many eyes successfully operated upon; it becomes less marked after removal of the aqueous humor. The lens, when removed from a glaucomatous eye, appears of a pale-orange color (from imbibition of hæmatin).

The position and the consistence of the crystalline lens become altered; its capsule, like the other textures, becomes rotten and readily ruptured, spontaneously, or during iridectomy. The cataract, which follows, or which may appear spontaneously, has a peculiar uniform gray, or greenish-gray, and opaque color; which sometimes is preceded by large, silvery striæ. The cataract at first is very large (swollen); gradually, chalky patches appear, with loosening of the attachments of the cataract, and sometimes with dislocation into the vitreous chamber.

The vitreous substance, in cases of acute glaucoma, when examined soon after the attack, is found transparent, and of normal consistence, with clots of blood suspended in it.

In chronic glaucoma it possesses unusual firmness; it is transparent, with a more or less yellowish tint. Clots of blood are comparatively rare in the vitreous chamber; if present, they are more numerous along the ora serrata, and near the hyaloid fossa.

In a staphylomatous eye, and in one in which the choroid had been separated from the sclerotic by spontaneous hemorrhage, the vitreous was more viscid in consistence; it was nearly fluid where it touched the displaced or staphylomatous portions of the tunics.

Part of the vitreous may be missing (having become absorbed?);

and the entire hyaloid membrane may be separated by yellowish fluid from the membrane limitans of the retina.

Impaired transparency of the retina and choroid renders recognition of the state of the vitreous difficult.

Mode of Impairment of Vision.—In simple glaucoma the impairment is so gradual that the sight of one eye may be lost without the patient being aware of it. Some patients state that vision has been lost gradually, both for distant and near objects; and this has been accompanied at times by rainbow colors round luminous objects.

Symptoms of glaucoma may exist for twelve or sixteen years before vision becomes sensibly impaired.

In "chronic glaucoma" we usually hear the patient complain of "attacks of dimness,"—of a "mist" round the flame of a candle,—and, in most cases, on injury of "rainbow color." Many observing patients state, that when looking straight forward, they no longer perceive objects held sideways.

The "*attacks of dimness*" are observed by most patients; and are supposed to coincide with temporary increased pressure upon the optic nerve (optic disk) and retina.

The retina and optic nerve may thus be paralyzed, without the optic disk appearing cupped.

Fatigue, excitement, and stooping are the usual causes of these attacks; which may appear at different times of the day, but generally do so towards evening.

Vision becomes "dim," not only when reading, but also when looking at distant objects; a mist appears to intervene between the eye and the object looked at.

"Normal light" may permanently be destroyed, within a few minutes, by acute glaucoma. Though reduced to perception of light, it may return to what appears to the patient a normal condition. In most cases, however, vision remains impaired.

The perception of "colors" of a "rainbow" round luminous objects (termed "irization," whether all the colors of the prism are present or not), is one of the most constant symptoms of glaucoma.

The colors generally assume the shape of a rainbow, in which the margin most distant from the flame appears red, and the one nearest the flame green, or bluish-green.

Irization, though generally not in the form of a rainbow, is observed by persons suffering from granular ophthalmia, and by many healthy eyes, if the pupil is much dilated.

Irization has been known to exist for ten or fifteen years previous to vision becoming impaired. In some cases of glaucoma it does not occur at all, in others only at certain stages; and disappears if the pupil is contracted beyond a certain size.

"Fiery stars," "flashes," intolerance of light, etc., are only occasionally observed.

In presbyopic persons, who use spectacles, we may suspect the presence of glaucoma, if their spectacles are repeatedly changed in the course of a few months.

The statement of the patient as regards vision should be followed by an examination of the functions of the retina; and when ascertaining these, we should pay particular attention to the condition of the peripheral portions of the retina. For a patient may be able to read small type (held opposite to the region of the yellow spot), and yet may have lost the use of the surrounding retina.

The peripheral portions of the retina are found impaired in all forms of glaucoma, and are often destroyed before vision for reading is much affected.

In simple glaucoma increased tension may exist for a long time before any diminution in the function of the peripheral parts of the retina is observed. The impairment, at the commencement, is only discovered when the examination is made in dull light. The peripheral parts of the retina, which lie to the outer side of the yellow spot, are generally first impaired.

Cases often occur in which the movements of the examiner's hand (the patient's eye being directed straight forward) are perceived opposite the outer parts of the retina; whereas opposite the inner, upper, and lower portions, not only can the movements be recognized, but also the number of fingers held up.

The peripheral portions of the retina above and below the yellow spot become impaired next, those inwards and slightly upwards last. The movements of the hand, placed outwards and below the eye (*i.e.*, opposite the inner and the upper parts of the retina), are often recognized while the rest of the retina is completely paralyzed. It is very rare to find those peripheral parts of the retina, which are to the inner side of the yellow spot, impaired first; as is often the case in amblyopia from cerebral changes. The upper half of the retina may, however, be paralyzed, while the yellow spot and the lower half remain sensitive for a considerable time.

The latter form of impairment of vision, by some, is termed hemiopia; while the other forms are described as contractions of the field of vision.

The contraction is slit-shaped if the still sensitive portion of retina has a somewhat oval figure, with the long axis of the oval placed horizontally.

As regards the efficacy of iridectomy, with reference to vision in glaucoma, it has been found that, as a rule, no favorable result is obtained if, previous to the operation, the paralysis of the retina has extended from the ora serrata to near the yellow spot; more especially if the latter has been situated close to one of the margins of the paralyzed part, and if, at the same time, the optic disk has been much cupped.

The results have been better if the yellow spot has been at an equal distance from the surrounding paralyzed or impaired portions of retina, or if much of the impairment of vision could be explained by the turbid condition of the contents of the aqueous and vitreous chambers. A good result has been obtained by the operation if, in the intervals between the attacks, vision has been but little impaired. The less the optic disk is altered, and the less the peripheral parts of the retina are impaired, the better is the prognosis.

General Remarks.—Glaucoma occurs most frequently between the ages of 50 and 60, but it has been observed between those of 7 and 40. In a case, aged 7, simple glaucoma of both eyes, and in another, aged 10, acute glaucoma of both eyes, occurred. Glaucoma, like senile cataract, always appear in both eyes, but rarely with equal severity, or simultaneously.

In one case 19 years elapsed before the second eye became glaucomatous. Glaucoma is more frequent in females; and appears, by preference, soon after cessation of menstruation.

In some families it seems hereditary; and undue hardness of the eye in other members of the same family is often observed.

Glaucomatous persons frequently suffer from "severe bilious attacks with sickness," from so-called rheumatism in the head, from sleeplessness, and from great prostration and dizziness.

Simple glaucoma occurs, seemingly by preference, in persons with a large, full, and hard radial pulse.

Attacks of erysipelas often precede chronic glaucoma.

Atheromatous changes in the cerebral and in the ophthalmic arteries have repeatedly been observed after death, in glaucomatous persons.

In *myopic persons*, when suffering from glaucoma, the increase of tension and the attacks of inflammation are less marked. The analysis of a series of cases, in which the ages varied from 14 to 50 (five being below 30), shows that the degree of myopia may vary from ⅛ to ½. The tension of the eyeball was found nearly normal in two, and but slightly increased in the other cases. Only in one case was there extensive atrophy of the choroid. In all the optic disk was deeply cupped. In all both eyes were affected, but in different degrees. Those not operated upon, lost vision; whereas those who were early operated upon, did well. In all cases the pigmentation of the choroid became very conspicuous round the optic disk, while previous to iridectomy in most a crescent had been the only sign of choroidal atrophy.

Hypermetropia is observed in a large majority of the cases.

Glaucomatous changes, *i.e.*, undue increase of tension, with its consequences, are of frequent occurrence after operations. They have been observed after operations for cataract (particularly after depression), and also after spontaneous dislocation of the lens, after injuries (traumatic cataract), adhesions of the iris to the cornea or to a cicatrix, and after an intraocular tumor.

Careful attention should be paid in such cases to the tension of the eyeball, the state of vision, and the sensibility of the peripheral parts of the retina, so that the necessary steps may be taken in time to remove the abnormal tension.

Treatment.—Numerous surgical and medical means have been made use of in the treatment of glaucoma. Local or general bleeding, mercury, opium, etc., may seem to have checked "the disease;" or several attacks of inflammation may have passed off spontaneously, and left vision but little impaired; but it has been found that, if glaucoma be left to itself, or be treated medically only, or by inefficient surgical means, or at too late a period, vision sooner or later is destroyed.

Tapping of the aqueous chamber, and frequent instillation of a strong solution of atropia, afford temporary relief. When once the tension has increased to a certain extent, atropia seems no longer to pass into the eye.

Most oculists have adopted the operation of iridectomy as a remedy which, in numerous cases, has the effect of diminishing the abnormal tension of the eyeball. Every medical man should learn to perform this operation. In cases of acute glaucoma, where it is of the greatest service, and where immediate surgical aid is required, the difficulties of its performance are but few, for the textures of the eyeball are little altered, provided vision has been useful before the attack.

The operation is more difficult if the textures are rotten, as in simple and chronic glaucoma with much impairment of vision. The removal of a portion of iris is in itself a most harmless step, and never followed by serious consequences. No excuse exists for not performing the operation in acute glaucoma, especially if vision has not been good before the attack.

Persons who suffer from glaucoma, and whose sight is but little impaired, must be acquainted with the usual course of "the disease," and with its more serious symptoms. Patients should avoid those things which cause irritation of the eyes, such as much reading, "near work," mental excitement, sleepless nights, etc. We should urge the operation of iridectomy if we find the peripheral parts of the retina already impaired, or if attacks of dimness, with increased tension, appear at short intervals.

Patients who have lost one eye by glaucoma are more readily induced to have the operation performed.

The longer the operation is postponed, the less favorable is the result.

Secondary changes (mostly of an atrophic character) in the structures of the eye, brought on by long-continued pressure, are not remedied by iridectomy.

Accidents which may arise during the operation, such as hemorrhage into the retina, wounding of the crystalline lens, loss of vitreous, etc., diminish much the chances of success.

As the result of careful examination of the retina, before and from six to eighteen months after iridectomy, properly performed, the following conclusions have been arrived at:—

(1.) That the operation may be recommended as long as there is perception of light; and, in acute glaucoma, even if perception of light has been lost for a week after the attack.

(2.) That the usual causes of failure are—advanced structural changes of the optic nerve of the retina; fresh increase of tension; hemorrhage, especially in the region of the yellow spot, or into the optic disk; and accidents during or immediately after the operation, as intraocular hemorrhage, etc.

(3.) That in the majority of cases, the amount of vision is preserved which the patient had before the operation, and that for months vision continues to improve.

(4.) That the result is the less favorable the more the paralysis of the retina has approached the yellow spot, especially if it has done so more from above and below; or if the sensibility of the region of the yellow spot is so much diminished that the patient, when looking at an object, turns the eye to one side ("eccentric fixation").

(5.) That if we find the aqueous humor turbid, the transparency of the vitreous substance impaired, and the entire retina sensitive, a better result is obtained by iridectomy than if these are clear, with a similar amount of impairment of vision.

(6.) That in acute glaucoma the pain ceases almost immediately. (From four to six leeches should be applied at bedtime to the corresponding temple, if the pain returns soon after the operation.) The external "inflammation" and the turbid state of the media, as a rule, disappear after from ten to fifteen days.

(7.) That the less the eyes are used for near work, the more satisfactory and lasting is the result of iridectomy.

For the changes which the various structures undergo after the operation, see above—cornea, iris, optic nerve, etc., etc., in glaucoma.

The pain attributed to pressure upon the ciliary nerves is felt in the eye and over the corresponding side of the forehead and temple, sometimes extending into the nose and the teeth.

It may be so severe as to deprive the patient of sleep and appetite for days. It is so rare in simple, intermittent in chronic, and sudden as well as sharp in acute, glaucoma. In the latter the eye in the ciliary region is tender to the touch. Pain may appear with equal severity in blind glaucomatous eyes. It has been arrested for a time, by injecting from ⅛ to ⅓ of a grain of morphia, beneath the skin of the temple. It generally ceases at once after iridectomy.

Blind glaucomatous eyes, if painful, should be excised.

THE OPERATION FOR ARTIFICIAL PUPIL AND THE OPERATION FOR IRIDECTOMY.

The object of the operation for artificial pupil is to establish a new pupil.

The operation differs from "iridectomy" in the smaller quantity of iris removed, and in its object being merely to improve vision; whilst that of iridectomy is to influence the tension and nutrition of the eye.

The operation for artificial pupil may be performed on one or both eyes, provided there be sufficient perception of light, no iritis, and no increase of tension.

The operation for artificial pupil is indicated—

(1.) In dense opacity of the cornea, with or without synechiæ.

(2.) In closed pupil, with or without synechiæ.

(3.) In lateral displacement of the crystalline lens, where its margin interferes with the functions of the natural pupil.

(4.) In stationary opacities of the crystalline lens, or of its capsule.

(5.) In obstinate myosis.

The operation of iridectomy is performed on one or both eyes—

(1.) In suppuration of the cornea, especially if at a future period, on account of opacity, an artificial pupil might be required, or if otherwise paracentesis might have been performed.

(2.) In some forms of chronic iritis, choroiditis, or ophthalmitis.

(3.) For the removal of foreign bodies from the interior of the eye.

(4.) To relieve the irritation caused by swollen particles of the crystalline lens.

(5.) Preliminary to extraction of cataract, especially if synechiæ exist; or after extraction, if the iris has been much bruised.

(6.) In various forms of staphyloma.

(7.) In hemorrhage into the vitreous chamber.

(8.) In glaucoma.

ARTIFICIAL PUPIL.

As regards the advisability of the operation for artificial pupil, if the fellow-eye is sound, it must be remarked that an enlargement of the field of vision is frequently the sole advantage obtained.

The artificial pupil should be made as small, central, and well-defined as possible, and behind the most transparent portion of the cornea, and that which is least altered in curvature. A careful examination by lateral illumination of the curvature and transparency of the cornea, of the appearance of the natural pupil, and of the state of vision, must precede the operation.

During the operation we act on the supposition of the crystalline lens being transparent. If we find it opaque, we enlarge the incision in the cornea, remove more iris, and extract the opaque lens with the scoop, hook, or syringe, or break it up with the needle, and allow it to become absorbed. If it has been removed and the pupil has become closed afterwards, we proceed as stated below.

On the day preceding the operation atropia is applied to the conjunctiva of the eye we wish to operate upon.

Chloroform must be administered in most cases, unless the patient be very quiet, and no complications are expected during the operation.

The Operation.—The patient is placed upon a bed, with the head slightly raised. The operator, standing behind, introduces the stop-speculum, to keep open the eyelids to the desired extent, and fixes the eyeball with the forceps, if possible, taking hold opposite the point where he proposes making an incision. The incision is made with a cataract-knife, or with one of the straight or bent lancet-shaped knives, by passing the instrument slowly through the cornea or sclerotic into the anterior chamber, holding the blade as nearly as possible parallel with the anterior surface of the iris.

The width of the incision depends upon the kind of operation we wish to adopt.

A very small incision suffices if we propose using the iris-hook or the canula forceps. A larger incision is necessary for the use of the iris forceps.

Having obtained an incision of the proper width, we slowly withdraw the knife, when from the escape of aqueous humor, and from the advance of the iris towards the cornea, we infer that the incision leads into the anterior chamber.

We now proceed to the formation of the artificial pupil.

METHODS OF "MAKING" AN ARTIFICIAL PUPIL.

(1.) *By Corepolinanoixis*, that is, by reopening the natural pupil, by removing any opaque membrane from its area, that may have remained there, *e.g.*, after iritis.

Excellent results have been obtained by this operation, which, if the crystalline lens is not wounded, and the opaque membrane is but loosely attached to its capsule, admits of restoring, as regards position, the original pupil. The opening into the anterior chamber is made with the smallest lancet-shaped knife through the sclerotic near the cornea. The point of the knife, if the entire margin of the pupil is adherent, is thrust through the iris, behind that portion of its margin which lies farthest from the incision in the sclerotic.

Having thus made an opening to allow of the iris-hook being carried behind the iris, the knife is quickly withdrawn, so as to lose but little aqueous humor. The hook is then introduced, and its short, bent portion carried through the artificially-made, or through an already existing, opening behind the margin of the pupil. The short portion of the hook, being turned towards the crystalline lens, is made to glide behind the opaque membrane, which, on withdrawing the hook gently, may be seen following in its wake. The membrane, which is generally elastic, need not be drawn out of the anterior chamber, but may be detached from the greater part of the margin, and from the area of the pupil, and left to itself. We should select another mode of operating if, after one or two attempts, we do not succeed in passing the hook behind the membrane.

(2.) *By Corelysis*, *i.e.*, by separating adhesions of the iris from the anterior surface of the capsule of the crystalline lens. The pupil must be thoroughly under the influence of atropia.

The incision is made in a part through which the largest number of synechiæ can be reached. The instrument, after having made the opening large enough to admit a spatula or iris-hook, should be withdrawn quickly, to avoid losing aqueous humor; for the less is lost, the more effectual are the movements of a hook or spatula.

To detach the adhesions, we pass a blunt iris-hook or a spatula close to an adhesion behind a not adherent part of the margin of the pupil; or, if the entire margin be adherent, behind a portion which previously has been separated from the capsule of the crystalline lens, as is done in corepolinanoixis.

The instrument is then carried on behind the iris, until it is supposed to have passed beyond the adhesion or adhesions.

By a to-and-fro movement with the hook or spatula behind, and as parallel as possible with the iris (so as not to wound the capsule of the lens), and thence through the pupil into the anterior chamber, we detach some or all of the adhesions from the capsule. A more or less circular, active, and clear pupil is frequently obtained.

(3.) *By iridectomeenkleysis*, in other words, by cutting off part of the iris, leaving part entangled in the corneal incision.

(4.) By *iridoialysis*, *i.e.*, by tearing away the iris from its insertion.

A sharp hook (or an iris forceps) is introduced through an incision in the cornea up to the insertion of the iris; a portion of which is seized and torn away from its insertion. The entire iris can in this way be readily removed. A pupil is thus formed close to the margin of the cornea.

The incision through the cornea, or through the opaque substance occupying its place, should be made at a spot through which the instrument, used for removal of the iris, can easily reach the insertion of the iris.

This mode of operating has been found of use in cases in which only a narrow rim of cornea has remained transparent; and in cases in which it has been desirable to diminish the tension of the eyeball, without removing any iris.

(5.) *By making an incision through a portion of the iris, without removing any.* This method has been employed in cases in which a great part of the iris, along with the pupil, has been adherent to the cornea, or to a cicatrix, which has occupied its place; the crystalline lens being absent, or opaque.

The incision is made by thrusting the small, or middle-sized, lancet-shaped knife through the cornea or cicatrix, near the part of the iris we wish to divide, and then into and through the iris. The stretched fibres of the iris are expected to recede from the line of insertion. This operation is also employed in cases in which, after absorption or removal of the crystalline lens, the iris has become adherent to parts (capsule, hyaloid fossa, etc.), which are themselves thickened and opaque.

In such cases an artificial pupil, when made in any other way, frequently becomes closed again; whereas extraction with the hook or forceps, of the opaque parts, may be followed by destructive inflammation.

In these cases a middle-sized lancet-shaped knife is thrust through the cornea, near its margin, and through the adjacent iris into the vitreous chamber. The knife is withdrawn quickly, so as to lose as little fluid from the vitreous chamber as possible, and a pair of iris scissors is introduced, closed, through the incision in the cornea. Arrived in the anterior chamber, the blades of the scissors are opened—one to pass through the incision behind the iris, and behind the parts adherent to it, into the vitreous chamber; and the other to glide along the surface of the iris, across the anterior chamber.

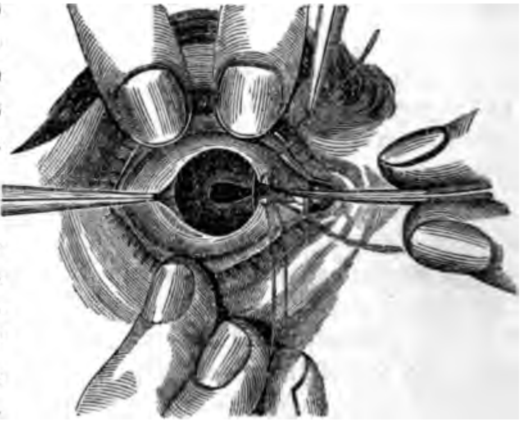
The blades are then closed, and the largest possible incision made, through the parts between the blades.

Useful vision has been obtained by this mode, where other methods had failed.

(6.) *By iridodesis, or iridesis, i.e.*, tying with silk a portion of the iris, after having drawn it through an incision in the cornea, as is shown in Figure 34.

The operation has been performed in cases in which the natural pupil has been entirely or in part preserved.

An incision, just large enough to admit a very small iris hook or canula forceps, is made thro' the margin of the cornea into the anterior chamber (too large an incision may allow the loop of silk, together with the included iris, to slip into the anterior chamber).



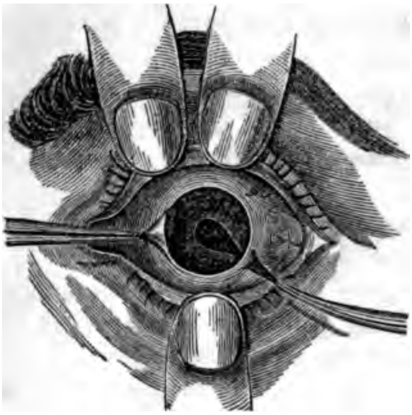
(Fig. 34.)

A small loop, made of a piece of very fine black silk, is laid upon the eyeball, round the incision, in such a manner that each end of the loop can readily be grasped with ciliary forceps by an assistant.

The small iris-hook (which is more manageable than the canula forceps, and less likely to bruise the iris) is passed through the loop and incision in the anterior chamber, and the iris which we wish to tie is drawn out through the incision, and through the loop. The assistant, in readiness with the ciliary forceps, draws the loop tight, as soon as the operator, having withdrawn the desired quantity of iris, directs him to do so. By this means, the withdrawn portion of iris is fixed outside the eye. The assistant, when tightening the loop, should closely follow the curvature of the sclerotic, and not draw its ends away from the eyeball. One end of the silk thread is cut short; the other is left about a quarter of an inch long, to allow of withdrawing the loop, which, if it has not fallen off after the eighth day, should be removed.

The advantage of this mode of operating is, that the "artificial" pupil retains its contractility. The disadvantages are, that a small staphyloma of the conjunctiva, with escape of aqueous humor beneath that membrane, often remains, and also that troublesome iritis occasionally follows.

Iridenkleisis.—Strangulating an artificially excited prolapsus, in a long and narrow opening, is then an advantageous substitute for the complicated *iridodesis*. For the purpose of performing this, we proceed exactly as in iridectomy; but the incision is made three-quarters of a line from the corneal border, on the sclerotic, and the lancet-shaped knife is entered very obliquely, and only so far that the inner opening of the wound has a length of not more than a line. Then the iris is pulled out of the


(Fig. 35.)

opening, as may be required, with the forceps (*vide* Fig. 35), but the prolapse is simply felt. The after-treatment is the same as in iridectomy. The prolapsed portion falls off after some days. In case it remains longer, and becomes finally troublesome, it may be simply removed. No reason follows, as a rule.

(7.) By *coremorphosis*—that is, by exercising a small portion of iris.

This is the usual and the easiest mode of "making an artificial pupil".

An incision, sufficiently large to admit of the free passage of the iris-hook which we propose to use, is made with a cataract or lancet-shaped knife, through the sclerotic, close to the margin of the cornea. The iris-hook is introduced through the incision, and carried along the posterior surface of the cornea, until its short bent part, somewhat turned towards the cornea, has passed beyond the margin of the pupil or the part of the iris we intend to withdraw. Then, by slightly rotating the handles of the hook, we cause the short bent part to turn towards the pupil, without, however, pressing it in that direction.

We now slowly withdraw the hook, which should cause the short bent part to glide behind the margin of the pupil.

Whilst withdrawing the hook, and with it some of the iris, we again rotate the handle, so as to cause the short bent part, together with the iris held by it, to turn towards the cornea. This turn we give the hook, before its short bent part has reached the margin of the incision, and thus prevent the hook from becoming arrested at that margin. An assistant cuts off the iris, which has been withdrawn, with a pair of iris scissors; close to the hook, if a small, close to the eyeball, if a large, pupil is required.

By drawing out the iris more or less we can, in a great measure, regulate the size of the artificial pupil.

It is preferable, if the margin of the pupil is adherent throughout (as previously ascertained by instillation of atropia), to use, instead of the hook, the iris forceps. The incision, in this case, must be larger, to admit of easy manipulation of the iris forceps.

IRIDECTOMY.

Instruments.—A thin, stop-speculum (to keep the eyelids open without stretching the conjunctiva too much, and without causing pressure upon the eyeball). A pair of forceps to fix the eyeball (for this purpose, forceps with sharp points, to enter the sclerotic, are required, if the conjunctiva is so rotten that it tears when grasped).

Straight and angular lancet-shaped knives, of different sizes. A pair of iris forceps, a pair of blunt-pointed iris scissors, and a turette.

The Operation.—The patient, placed in a recumbent position, with the head slightly raised, is brought thoroughly under the influence of chloroform, so as to avoid all straining. The operator, standing behind the patient, introduces the stop-speculum, to keep the eyelids open to the desired extent.

With the forceps ("to fix the eyeball") he seizes the conjunctiva and subconjunctival tissue (or, with the sharp-pointed forceps, the sclerotic, if the conjunctiva should tear) close to the margin of the cornea, and, as nearly as possible, opposite the spot where the point of the knife has to enter. Previous to commencing the incision the eyeball should be rotated in various directions, so as to insure its being well secured. The point of the knife is then thrust slowly through the sclerotic into the anterior chamber, just in front of the insertion of the iris; care being taken to keep the point, while in the anterior chamber, directed towards the cornea, so as to avoid wounding the crystalline lens. The knife, having entered the anterior chamber, is carefully pushed on until the incision has the desired size. The width of the cutting-blade of the lancet-shaped knife should be such that the desired size of the incision is obtained whilst the knife is advancing into the anterior chamber. The incision, if not wide enough, must be enlarged while withdrawing the knife.

The knife, after completing the incision, is gently withdrawn; its point being kept inclined towards one or the other side of the anterior chamber, away from the area of the pupil, so as to avoid wounding the lens, and to prevent too rapid escape of the aqueous humor.

If, previous to making the incision, there is little or no aqueous humor, so that the iris nearly touches the cornea; especially if, at the same time, the pupil is much dilated, and, consequently, the lens more likely to be injured, then the incision is made with the smallest lancet-shaped knife; and some iris is drawn out with the iris-hook, and cut off. After a few days a larger quantity of aqueous humor has accumulated, when a larger iridectomy may be performed.

Instead of adopting this proceeding, we may enlarge the small incision with scissors (which is more difficult), and perform iridectomy at once.

Some, to obviate a cystoid cicatrix, commence the incision at the extreme margin of the cornea; thrusting the blade, perpendicularly, through the cornea, and, on reaching the anterior chamber, pass it on in the usual direction.

Better vision and better outward appearance of the eye is obtained by making the incision near the upper margin of the cornea. The subsequent steps of the operation are, however, rendered easier by making it near the outer margin.

The operator, after completing the incision, either confides the forceps to the assistant, who seizes and steadies the eyeball, or he does it himself, while the assistant is intrusted with the manipulation of the iris scissors.

The next step is the removal of a portion of the iris. The iris, if protruding from the wound, is seized with the iris forceps, close to one of the angles of the incision, and cut off as directed below. If the iris is not protruding, the curved iris forceps are closed, and introduced through the centre of the incision, and pushed onwards in front of the iris, and carried up to and not beyond the margin of the pupil; where they are allowed to open to the extent of the incision.

The iris, by pressure of the parts behind, is pushed between the branches of the forceps; it is seized by closing the forceps, without pushing them back towards the iris. The latter is then slowly drawn out through the incision, and, with the scissors, cut through, on the side of the forceps, close to one angle of the incision; care being taken to divide the iris from the margin of the pupil to its insertion. Having divided the iris at this point, we draw the portion grasped by the forceps towards the other angle of the incision; we thus tear it away from its insertion, and again divide it with scissors at the other angle. Before making this second cut, care should be taken to draw the iris towards the angle where it was divided first. Adhesions of the iris to the incision are thus avoided.

In this manner we remove the entire width of the iris, or nearly as much as corresponds to the length of the incision in the sclerotic.

The more widely the forceps are opened, the more of iris can be seized and excised.

Some are satisfied with the less difficult proceeding of cutting off, at once, the portion of iris which has been withdrawn with the forceps.

No iris should be left entangled in the incision. A flexible spatula or a scoop may be passed through the incision, at its angles; and any iris that may have remained there may be pushed back into the anterior chamber; care being taken not to wound the crystalline lens, nor its suspensory ligament.

The speculum is then slowly removed; and some lint, dipped in cold water, is tied over the closed eyelids, so as to exercise slight pressure, while the patient is recovering from the effects of chloroform.

Accidents during the Operation of "Iridectomy," or that for "Artificial Pupil."—

Experience is required as regards the distance from the margin of the cornea at which the incision should be made through the sclerotic.

By piercing the sclerotic too far from that margin, we may be led behind the iris, and wound the lens or some of the ciliary processes; or, with the point of the knife, tear the iris from its insertion.

The former accident has been followed by cataract, or by loss of "vitreous;" the latter by profuse hemorrhage into the chamber and beneath the conjunctiva.

Bleeding into the Anterior Chamber.—(1.) Through wounding the ciliary processes, or detaching the iris from its insertion. This accident may happen if the knife, entering through the sclerotic, is introduced too far from the margin of the cornea, or is not properly directed.

The bleeding may be so profuse as to oblige us to discontinue the operation. Severe traumatic iritis may follow. The point of the curette should be kept in the wound; and slight pressure made upon the eye, to encourage the escape of blood. If this does not succeed in removing the blood, it is better to postpone the other steps of the operation until all blood has become absorbed.

(2.) Through blood running into the anterior chamber, from cut vessels of the conjunctiva. This often occurs in eyes in which the tension is below par, or in which, from the protracted, extensive inflammation of the choroid and iris, with normal tension, and generally with total posterior synechiæ, the textures have lost their elasticity. To recognize such eyes, experience is required.

It is generally useless to attempt to remove the blood. Slight pressure, by means of wet lint tied over the closed eyelids, causes it to become more rapidly absorbed.

The incision should be made in such cases through the cornea; and the operation conducted in a manner to avoid, as far as possible, all sources of bleeding.

(3.) Through spontaneous bleeding from the iris.

This occurs more frequently if there is chronic iritis, or if the bloodvessels of the iris, after protracted iritis, have lost their elasticity. We sometimes succeed in removing the blood (if fluid) by suction, or by pressing upon the cornea with the finger or curette, or (if clotted) by drawing out the clot with the iris forceps. Clots of blood, if left, sometimes set up new iritis, and, occasionally, closure of the artificial pupil.

Pressure upon the closed lids, by means of wet lint, should be made until all blood has disappeared.

The aqueous humor may escape before the incision is completed, i.e., before it has the desired width.

The knife should be withdrawn, and the incision completed with blunt-pointed (strabismus) scissors; taking care to carry the point of that blade of the scissors, which is introduced into the anterior chamber, close along the insertion of the iris. An incision may thus be enlarged to any extent.

Some difficulty may be experienced in the introduction of the iris-hook or of the iris forceps. If the incision has been made through the sclerotic, very slight pressure with the instrument, upon the sclerotic, next the margin of the incision which is farthest from the cornea, will cause the incision to gape, and thus generally allow the instrument to pass. Occasionally some conjunctiva may have to be excised, or the incision may have to be enlarged, or even a second incision may have to be made through or near the cornea.

We may not succeed with the iris-hook in drawing out the iris, through the texture of the iris being so rotten that the hook passes through it, as it would through wet blotting-paper. In this case we enlarge the incision and remove the iris with the forceps.

The same proceeding is adopted if the margin of the pupil is adherent throughout; causing the short part of the hook to glide from the area of the pupil over its margin, instead of behind it.

Difficulties in the removal of iris with the iris forceps may arise through the texture of the iris being so altered by inflammation that it has become stiff, and often glazed over with transparent exudation, or adherent throughout to the capsule of the lens, so that it cannot be grasped by the forceps. In this case a lancet-shaped knife is thrust, close to the incision in the sclerotic or cornea, through and behind the iris into the crystalline lens. A square-shaped piece of iris and lens capsule is grasped with the iris forceps (one of the branches being passed through the incision behind the iris into the lens, the other in front of the iris), and torn away; or a piece of the iris and capsule are cut out with iris scissors. This step is followed by the removal of the crystalline lens. A similar proceeding is adopted if the iris, on account of its being too rotten, can only be removed in small particles; while the uvea remains adherent to the capsule of the lens.

Adhesions of the uvea to the capsule of the lens is the rule if extensive iritis has preceded the operation. The exercised portions of iris should therefore be placed in water, and examined for the presence of the uvea; and, if no bleeding has ensued at the time of the operation, lateral illumination should be used; by which means, in every case, the presence of uvea in the area of the artificial pupil can be discovered.

The uvea, during lateral illumination, may be scraped away with a spatula from the capsule of the lens. The treatment generally adopted, however, is to remove the capsule of the lens, with the uvea attached to it, and the lens itself.

Causes of Failure, or of Incomplete Success of the Operation for Artificial Pupil.—(1.) Opacities, and alterations in curvatures of the cornea (which may only become conspicuous after the operation); (2.) Pigment on the capsule of the crystalline lens; (3.) Cataract; (4.) Alterations in the shape of the eyeball; and (5.) Morbid changes of the choroid and of the other tunics.

1, 2, 3, can, as a rule, be discovered by lateral illumination; 4 and 5 by the use of the ophthalmoscope.

(6.) Hemorrhage into the anterior chamber. In this case considerable time must be allowed to pass before attempting a second operation. All inclination of the eye to "redden up," and all discoloration of the aqueous humor, should have disappeared before operating again. During the steps of a second operation, all things should be carefully avoided which had given rise to bleeding before, *e.g.*, an incision through the sclerotic, straining during the operation, wounding of certain portions of iris, etc.

A combination of several of the causes of failure of the operation is frequent; and often renders the treatment after the operation difficult. (See the *Treatment of Opacity of the Cornea, Cataract, etc.*)

Iritis attributable to the operation itself, is a rare occurrence; probably owing to the fact of the piece of iritis, seized with hook or forceps, being removed, and to the iris tissue, which is generally altered in structure, being less perceptible of inflammation.

(7.) *A so-called cystoid cicatrix, i.e.*, an incision which has become incompletely closed by loose opaque tissue, allowing the aqueous humor to escape beneath the conjunctiva: this gives the latter an œdematous appearance. In extreme cases the aqueous humor may extend beneath the conjunctiva, all round the cornea; whereas in slight cases there may be more bulging of the intervening tissue, between the margins of the incision. The cystoid cicatrix frequently occurs after the operation of iridesis, and after iridectomy, if the incision has been made through the sclerotic, and if some of the iris has remained entangled in the incision, or if increased tension has caused expansion of the tissue filling the incision. Generally no harm results, but suppurative iritis has been known to follow.

The local application of atropia, gentle pressure, by means of a bandage applied over the closed eyelids, or puncturing the bulging cicatrix with a broad needle, has been recommended.

The bulging of the conjunctiva, if troublesome, or disfiguring the appearance of the eye, may readily be removed; and the cystoid cicatrix closed, by passing a silk thread through the sclerotic, across the point through which the aqueous humor seems to escape. The thread is tied lightly, the ends are cut short, and the lids kept closed until the thread has come away spontaneously. The inflammation, caused by the presence of the thread, suffices to close the opening which leads into the aqueous chamber.

Closure or contraction of the artificial pupil is observed—(1.) In eyes with total posterior synechiæ; (2.) In eyeballs which are more or less shrunken, and the tension of which is below par.

Vision after the Operation for Artificial Pupil.—We may obtain binocular vision (the most favorable result) by most of the various modes of operating; if the retina is sound in the region of the yellow spot, and the artificial pupil not too near the margin of the cornea.

Strabismus may follow from non-use of the eye operated upon.

Sometimes diplopia occurs; which disappears either spontaneously, through both eyes acting together, or through the less distinct retinal image of the eye operated upon being no longer observed.

ANOMALIES OF VISION.

An object, *e.g.*, a luminous point, appears single if both visual lines are directed to the point. The point appears double if we look at an object placed in a straight line beyond it, while the object in its turn appears double, if we look again at the point.

Scotoma in the Region of the Yellow Spot (*Central Scotoma, Central Interruption of the Field of Vision, Impairment of Direct Vision*).—Scotoma in the region of the yellow spot may appear after looking into strong light, or after working too much at the microscope. It may appear in both eyes, if both are used in succession. In the eye thus used a yellowish mist is noticed. This mist is followed by a deep-brown one, if the work which caused it be continued. Objects placed opposite the region of the yellow spot can no longer be perceived. Hours may elapse before the mist has cleared away, and vision has become normal again.

The boundary of the impaired portion of retina is ill-defined, while the function of the more peripheral parts may continue undisturbed. With the ophthalmoscope, we observe an increased grayish haze, surrounding the reddish centre of the yellow spot.

From this kind of scotoma, which may occur whenever cause is given, we distinguish the one which appears more gradually, without any apparent cause, often in both eyes, and which remains.

On ophthalmoscopic examination, in the latter case, we may find choroido-retinitis and loss of transparency, followed by local pigmentation and atrophy.

Peripheral parts of the retina sometimes acquire, in such cases, a degree of acuteness which is not possessed by equally eccentric parts of the healthy retina.

Another form of central scotoma is that caused by cerebral or extraocular changes. In these changes the ophthalmoscopic examination is often negative, and the boundaries of the impaired portion of retina are very irregular. The arrest of the function of a certain number of optic nerve-fibres, *e.g.*, from cerebral changes, gives rise to impairment of the functions of those parts of the retina to which such fibres belong. A scotoma is observed opposite the impaired part of the retina, while the rest of the retina remains normal. The functions of the more eccentric parts of the retina are likewise annihilated, if the elements of the retina and the entire layer of optic nerve-fibres are destroyed.

The following mode of ascertaining the extent of small central scotoma (the fellow-eye being healthy) has been proposed:—

The patient is directed to look at a white spot on black, dull paper. To healthy eyes, the white spot, viewed through a blue-tinted glass, held before one, and through a yellow-tinted glass, held before the fellow-eye, appears of a dirty-green color. If the region of the yellow spot, *e.g.*, of the left eye, is impaired (the healthy right eye looking through the yellow, and the left through the blue-tinted glass, at a piece of white chalk, held at the side of the white spot), then the spot and the piece of chalk appear yellow. The chalk appears of a dirty-green color (on moving it along the black paper, away from the white spot, both eyes being fixed on the latter), the moment a point is reached where both retinæ participate in the act of vision. The shape of the impaired portion of retina can be found by ascertaining a certain number of such points.

An amblyopic or amaurotic portion, i.e., a scotoma, adjoining the optic disk, and, most frequently, the portion next the yellow spot. "Enlargement of the blind spot."

Small blind or impaired portions of the retina, adjoining the optic disk, are generally not noticed by the patient. Large ones, if encroaching upon the region of the yellow spot, betray themselves by portions of an object, situated externally to the point directly looked at, appearing indistinct or missing. The impaired portion is rarely irregular; generally it is transversely oval. Atrophic changes, commencing at the choroido-retinal aperture, and following inflammation or simple distention, as in extreme myopia, are the usual cause.

These changes, when recent and appearing rapidly, for a time impair ("dazzle") the vision of the fellow-eye.

To make the impaired portions of retina more strikingly perceptible, we cause the patient to look, with the affected eye, through a small opening, at a strongly illuminated white surface: the impaired portions appear as dark spots.

Amblyopia or amaurosis of other parts of the retina; eccentric scotomata; eccentric interruptions of the field of vision.

If eccentric portions of the retina are not destroyed, but only impaired, we find the patients complain of differently-shaped gray, black, or colored spots. These either obscure portions of an object, or cause them to appear indistinct, misty, or distorted, or too small, or too large. Small impaired spots are often overlooked, especially if confined to one eye, and are least perceived if the other eye is closed. They are generally the result of choroido-retinitis.

Amaurosis, progressing from the periphery (margin) of the retina towards the yellow spot; contraction or limitation of the field of vision.

The impairment of vision—(1.) May be confined to one-half of the retina ("hemiopic limitation").

(2.) May advance, to an equal extent, from all points of the periphery of the retina, towards the yellow spot ("concentric limitation"), as frequently occurs in both eyes of the same patient. A zone of amblyopic retina generally joins the amaurotic one.

(3.) May advance more rapidly from one side ("irregular limitation").

Of this latter, different varieties occur, *e.g.*, the amblyopia or amaurosis may progress more rapidly from the outer margin of the retina, as in cupping of the optic disk; or more rapidly from above and below, as in anæmia and atrophy of the optic disk; or irregularly, from all sides, as in the different forms of choroido-retinitis.

The "amaurotic" portions of the retina may join healthy portions; but more frequently they are contiguous with "amblyopic" ones.

Cerebral changes, affecting vision, lead simultaneously to eccentric limitation and to impairment of direct vision, but not to morbid changes in the retina.

If, from impeded innervation, or from non-use, direct vision is much impaired, while the eccentric parts of the retina remain sensitive throughout, the prognosis is better than if direct vision is good, but the eccentric parts are much or irregularly impaired.

Amaurosis, from overuse of the eyes, through fine work, microscopic or telescopic work, or from sudden exposure to strong light (lightning).

The region of the yellow spot is the part usually impaired.

With the ophthalmoscope, we may find choroido-retinitis. Exposure to strong light has even given rise to ophthalmitis of the exposed eye. In other cases no changes are discoverable within the eye, with the ophthalmoscope.

Anomalies of vision, which are caused by extra-ocular, and especially by cerebral causes, often present no marked objective symptoms beyond the impairment of vision. The eye, the vision of which is disturbed, may appear quite healthy, or there may be but slight alteration in color of the optic disk.

To decide upon the prognosis and treatment of such cases, it becomes necessary to examine other functions of the body.

The following are symptoms which frequently precede or accompany the cerebral lesions, which give rise to impairment or loss of vision:—

Headache.—Headache, in itself, is no guide as to the cause and seat of the lesion, which may have given rise to impaired vision. It may precede the impairment of vision for years, and is attributed to morbid changes in the dura mater.

Anæmia and atrophy of the optic disks of both eyes, are the changes which are finally observed with the ophthalmoscope.

Vomiting.—We should ascertain what kind of vomiting there has been; whether of bile (the age of the patients attacked by this kind of vomiting varies, as a rule, between 18 and 30),—or of blood (the age of the patients varies between 40 and 50). We should also inquire whether there has been obvious cause for it, or whether it has appeared after meals, or at any other time. The vomiting may be a reflex action, which ceases as the ocular changes progress; or it may be connected with morbid changes about the medulla oblongata, or at the roots of the eighth nerve.

Vomiting and headache with amblyopia or amaurosis are, as a rule, signs of cerebral disease. Inflammation of the optic disk of both eyes is the morbid change which is frequently found in ophthalmoscopic inflammation.

Giddiness is often complained of, long before lesions of vision occur, by persons suffering from heart disease, with intermittent pulse, or from rigid arteries, or from derangement of the circulation, in consequence of cerebral changes.

Convulsions ("epileptic fits") of otherwise healthy, or of paralyzed parts.

Neither the character nor the frequency of the fits is a guide as regards the nature of the lesion, which may have given rise to defective vision. If confined to one side, we may suspect the cause of impaired vision to lie near, or at the corpus striatum. The fit is sometimes preceded by complete blindness; the latter is attributed to temporary anæmia of the retina, from spasm of the coats of its bloodvessels.

Hemiplegia is a frequent forerunner or companion of disturbance of vision. If the two appear simultaneously, they are attributed to apoplexy near or in the corpus striatum, or thalamus opticus. If the hemiplegia precedes the amaurosis for a long time, then we may attribute the latter to secondary cerebral lesions; or if it occurs suddenly, to fresh apoplexy. In amaurosis with hemiplegia of the right side, and with loss of speech, both hemispheres have repeatedly been found diseased.

Amaurosis, when occurring on the same side as the hemiplegia, is attributed to embolism. Amaurosis from inflammation of the optic disk of both eyes, without anomalies of locomotion, is generally complicated with, or caused by, lesion of the cerebellum or of the hemispheres.

Eleven patients suffering from this anomaly, all of the middle age, have come under observation within the last four years. They complained, at first, of great general weakness (including that of the genital organs), of a sensation of "pins and needles" in the lower extremities, and of numbness, accompanied by a painful feeling of constriction of the chest. Then followed cramps in the feet and trembling of the hands, especially when attempting to seize objects. Two months after the first symptom of "ataxy" had appeared, vision became impaired, a mist "appearing before the eyes, and gradually getting thicker." The blood-supply to the retina and choroid remained normal, but the optic disks rapidly became anæmic, and remained so even in the cases in which the acuteness of vision rose from $\frac{1}{18}$ to $\frac{1}{6}$.

The treatment of these cases by nitrate of silver has been attended with favorable results. The nitrate of silver is supposed to have restored the normal relation between the optic nerve-fibres and the nerve-cells, in the corpora quadrigemina.

In the cases in which there was no perception of light, no effect was produced, while in the patients who could still read large letters, the acuteness of vision rapidly (within from four to ten days) increased. After six weeks all signs of ataxy had disappeared.

The nitrate of silver is given twice daily, in doses of a quarter of a grain, gradually increased to one grain.

Causes of amblyopia and of amaurosis.—(1.) *Ocular* (*in the retina, choroid, or optic nerve*). (2.) *Extra-ocular* (*orbital*). (3.) *Cerebral or spinal.*

Cerebral changes, accompanied by great disturbance of the circulation within the head (as observed during rapidly-growing cerebral tumors, and during meningitis), are often complicated with hyperæmia of both the retinæ, with rupture of retinal blood-vessels, swelling of the optic disks, etc. Anæmia and atrophy of the optic nerves are usual changes observed during certain chronic cerebral changes. Such cerebral changes may be far away from the optic nerve-fibres, and yet, through pressure, etc., impair their functions. There may be extensive disease of the hemispheres, with perfect vision. Morbid changes of the right hemispheres are more often complicated by amaurosis.

Changes confined to one side of the brain may cause hemiopia, but never complete amaurosis.

Amaurosis or Amblyopia (a) from Intra-cranial and Cerebral Tumors.—The usual seat of such tumors is the basis cranii, especially the sella turcica and the neighborhood of the cerebellum.

Loss of vision is produced either by pressure, impeding the functions of the optic nerves or the circulation, or by complication with inflammation of the optic nerves, with meningitis, etc.

The most frequent changes observed with the ophthalmoscope in the course of cerebral tumors are—hyperæmia,—œdema,—inflammation of the optic disks and retina,—anæmia, or anæmia with atrophy of the optic disks. Slight protrusion of the eyeball, with fulness of the veins about the eyelids, is an occasional complication of tumors at the sella turcica, or at other parts of the basis cranii.

Amaurosis (b) from Morbid Changes at the Base of the Brain.—The most frequent change observed is meningitis (tubercular, pyæmic, typhoid). In some cases the impairment of vision appears at the time of meningitis; in many, long after the meningitis has passed. Both optic nerves, or one, or only part of one, may be affected. Amaurosis of both eyes, in these cases, is generally complicated with paralysis of other cerebral nerves.

Amaurosis (c) following Apoplexy, or Softening, or Tuberculosis, or Abscess of the Brain.—The lesion of vision is often complicated with paralysis of separate spinal nerves, or of other spinal nerves, with hemiplegia or paraplegia. Apoplexy is a frequent cause. It may appear simultaneously in the eye and brain. Monolateral hemorrhage into the thalamus opticus causes hemiopia. To produce blindness, hemorrhage must occur on both sides. Hemorrhage into the chiasma may cause blindness. When occurring at other parts of the basis cranii, it generally affects the third nerve also.

Simulation of Amaurosis or of Amblyopia (1) *of both Eyes.*—This has been observed in insane persons, and in others, with a view of obtaining a certificate of blindness. Simulation may be suspected, if both pupils are active, and if it is stated that light cannot be perceived. We may be unable to express an opinion if the person only denies the power of recognizing objects.

Simulation of Amaurosis or of Amblyopia (2) *of one Eye* (*generally of the Right*).—If the pupil of the supposed blind eye (provided it be not under the influence of a mydriatic, and the fellow-eye be thoroughly excluded from light) does not contract when suddenly exposed to strong light, but does so when both eyes are open, we can pronounce the first eye to be blind. We should, if any doubt remains, after having carefully examined the "supposed" blind eye, place a strong prism, *e.g.*, one of 12°, with the refracting angle downwards, before the good eye. The patient is directed to look at the flame of a candle, when the simulation at once becomes apparent, if he states that he sees two flames (attributing them to the suction of the prism on the sound eye).

Amaurosis with Disease of the Spinal Cord.—Tenderness, on pressure in the region of the first cervical vertebra, with impairment of vision, has been observed to precede the amaurosis.

The ophthalmoscopic symptoms, in advanced cases, are anæmia and atrophy of the optic disks and retinæ. The atrophy of the optic disks is, in some cases, the first of a series of symptoms arising from spinal changes.

Much benefit has been derived, in some cases, from repeated blisters applied to the cervical region.

The *post mortem* examination of some cases has shown atrophy of the trunks of the optic nerves, and morbid changes, *e.g.*, atrophy in the thalami optici.

As causes have been observed injuries, inflammation, atrophy.

Reflex amaurosis (*f*) *from "irritation," originating in one of the sensitive nerves, or from "irritation" of other parts of the nervous system.*

Cases belonging to this group occur, not frequently without any apparent changes in the eye (the optic disks, among other parts, appearing healthy), or in the functions of the cerebrum or cerebellum.

The amblyopia or amaurosis is attributed to alterations in the tubercula quadrigemina; which alterations are supposed to be the result of "irritation" elsewhere, *e.g.*, of injuries to the spinal cord, or irritation of the frontal nerve, of neuralgia of the face, of gastralgia, of irritation, caused by worms.

The disturbance of vision following such irritation, the increase or decrease of vision keeping step with the irritation, and improvement of vision, on cessation of the supposed cause, justify the assumption of a reflex amaurosis.

Amaurosis or Amblyopia (h) from General or Constitutional Causes.—(1.) *Appearing among other symptoms of albuminuria.* (2.) *During syphilis.* (3.) *During diabetes mellitus.* (4.) *Through embolism.*

The morbid changes comprised under (1), (2), (3), and (4), when localizing themselves in the eyes, assume certain characteristic forms, *e.g.*, that of effusion of lymph, in syphilis, that of peculiar infiltrations with rupture of bloodvessels, in albuminuria, etc., etc. If, on the appearance of amaurosis or amblyopia, we find the eyes intact, and, after examination of other organs, discover albuminuria, syphilis, etc., we adopt the same general treatment, which would have been carried out if the eyes had been attacked.

Amaurosis (k) appeariny during Irregularities of Menstruation, during Pregnancy, Parturition, or Lactation.—Sudden amaurosis, appearing about the time when menstruation has been expected, has been observed, in two cases, to subside again, after the reappearance of that function. Vision returned gradually, in both cases, and has remained normal.

Cases of recurring amblyopia or amaurosis, commencing at some period of pregnancy, and subsiding after parturition, have repeatedly been recorded.

A frequent cause of amblyopia or amaurosis, after sudden arrest of menstruation, is the occurrence, at that period, of intraocular or of cerebral hemorrhage; which has been preceded, in several cases, by severe pain in the head, with unconsciousness.

The morbid changes, which give rise to lesion of vision during the above changes in the body, in many respects resemble those observed during albuminuria, and may be divided into three groups:—(1.) Cases in which the chief symptom is hemorrhage within the eye, with œdema of the parts adjoining the seat of hemorrhage; (2.) Cases in which infiltration (inflammation) appears with the subsequent changes of texture (generally at and near the optic disk); and (3.) Cases in which no lesion is discoverable within the eye.

Amaurosis (*l*) *from Anœmia* (*Ischœmia*).—(1.) Anæmia from general causes, *e.g.*, from diabetes, diarrhœa, spermatorrhœa, loss of blood. Vision, in these cases, is lost; in some gradually, in others suddenly. Much good may be done, if the impairment is not considerable, by improving the general health; while if the ophthalmoscopic signs of atrophy of the optic nerve and retina have appeared (and the sooner the worse), little hope remains, though the general health may have been restored.

Vomiting of blood has been accompanied or followed by sudden loss of vision of one eye, or of both. If one eye only is affected, the other generally becomes impaired in from one to six months later. Vision, in such cases, if lost suddenly, often remains lost, though the general quantity of blood may have been restored. The anæmia and atrophy of the retina and of the optic disk appear at a later period. There may have been amaurosis for some time, while, with the ophthalmoscope, we find only slight anæmia, or no changes at all. The loss of vision is not explained by the quantity of blood lost, nor by anæmia of the brain, since other cerebral functions return as the quantity of blood increases.

The amaurosis sometimes appears while the patient is recovering from the loss of blood. In some cases the loss of blood has been so slight that the amaurosis could not be attributed to it.

Several of the patients suffered from ulceration, with sloughing of the mucous membrane of the stomach. Their ages varied from between 40 and 50.

(2.) Amaurosis or amblyopia from anæmia from local causes.

Gradual compression of the artery of the retina is followed by impairment of the functions of the retina, in the region of the yellow spot. Sudden obstruction causes sudden amaurosis. The less arterial blood enters the retina, the more is vision impaired.

Amaurosis (*m*) *produced by Tobacco, or Lead, or Quinine, or Alcohol.*—These substances often produce spasm, or paresis, or paralysis of the ciliary muscle; and we must guard ourselves against mistaking for amblyopia or amaurosis the disturbances of vision due to these conditions.

By Tobacco.—The patients generally are of middle age, thin, of pale-yellow complexions, and rarely complain of pain in or about the eyes. They generally state, that the impairment of vision has progressed slowly. Vision may, however, within six months, be reduced to mere perception of light. The impairment of vision (if the disease is progressing) reaches this degree in from six to eighteen months. Both eyes are affected, though in varying degree. One eye may become blind without the patient being aware of it. Night blindness and decrease of acuteness of vision, for distance, are often the earliest objective symptoms. Photopsia frequently appears, and sometimes after all vision is lost.

With the ophthalmoscope, we observe, at first, hyperæmia of the optic disk, with anæmia of the retina. Anæmia and atrophy of the optic disk and retina finally follow. The greater the diminution in the number of arteries in the retina, the greater is the impairment of vision. *Post mortem* examinations have shown traces of basilar meningitis, which has affected the optic nerves, and also the third and facial nerves.

By Lead.—Impairment of vision from medicinal application of lead has been observed in two cases, and from working with lead in several cases. In the former, protracted headache was followed by sudden loss of vision in the right, and, twenty-four hours later, in the left eye. This was complicated with paralysis of the ciliary muscle and iris, and with some increase of temperature. In one case vision returned after the use of mercury (to salivation), followed by that of iodide of potassium. In one of the latter cases no morbid changes, except extreme anæmia, were discovered on *post mortem* examination.

By Quinine.—Deafness and noises in the ears are usual complications. With the ophthalmoscope, we find a tortuous condition, or, at least, an overfulness of the veins of the retina, in the otherwise healthy eye. Much benefit has been derived from repeated bleeding.

By Alcohol.—In one case in which vision was reduced to mere perception of light, during prolonged abuse of alcohol, the optic disks appeared healthy. Vision, after drinking was discontinued, and leeches had been applied to the temples, returned rapidly, so as to allow the patient to follow his employment.

Amblyopia of one Eye (n) from Non-use, after Prolonged Exclusion.—This form of amblyopia reaches a high degree, only, if it be congenital, or of very long standing. It may remain undiscovered for years.

Cases have occurred in which the functions of the retina of one eye have seemed to interfere with those of the fellow-eye. In these cases, direct vision of one eye gradually becomes impaired. The development of higher degrees of amblyopia seemed to be prevented. in some of these cases, by the pupil becoming closed, or cataract developed. Paralysis or paresis of the iris, and of the accommodation, opacities of the cornea, and especially strabismus of one eye, are usual complications.

INJURIES OF THE RETINA AND OF THE OPTIC DISK.

The retina readily undergoes suppuration, together with other tunics, during ophthalmitis, after injury. During operations on the deeper parts of the eye, the retina may be wounded; or it may become lacerated by foreign bodies passing through it, without the ensuing inflammation extending beyond the seat of injury. (See *Retinitis, Ophthalmitis, and Injuries of other Tunics, and of the Vitreous Substance.*)

Concussions by blows, etc., may be followed by displacement of the retina, or by rupture of its bloodvessels, or by glaucoma, or by ophthalmitis, or by a combination of these.

The changes of the retina, as seen with the ophthalmoscope, have appeared, in many cases of concussion, confined to the bloodvessels. These, especially the veins, have appeared more numerous and unequally dilated; and more so if the injury has given rise to hemorrhage into the vitreous chamber. In the majority of cases the arteries and veins have been found abnormally thin, and have remained so for months; while those of the fellow-eye have appeared more numerous, and, on the slightest pressure, have shown pulsation.

The optic disk, as a rule, appears unduly vascular, and sometimes as red as the choroid.

This is occasionally followed by anæmia, with some atrophy, if inflammatory changes have appeared in or near the optic nerve.

Rupture of the choroid, near the optic disk, leaving a bluish-white cicatrix, is an occasional complication.

Traumatic choroido-retinitis round the optic disk, with or without inflammation of the latter, has, in several instances, led to complete loss of vision, without externally altering the appearance of the injured eye.

AMBLYOPIA OR AMAUROSIS, WITH APPARENTLY HEALTHY OPTIC DISK.

Cases of sudden loss, or of rapid impairment of vision, if examined with the ophthalmoscope soon after the impairment or loss of vision has occurred, often present no perceptible changes as regards the optic disk.

As causes of such loss of vision have been observed—cerebral apoplexy;—echinococcus in one of the hemispheres;—hemorrhage from the stomach or uterus;—general impairment of nutrition;—neuralgia in the face or eye;—periostitis of the facial bones;—inflammation accompanying "carious" teeth.

If confined to one eye, anæmia of the retina may be observed in the affected eye. In some cases it is difficult, even for an experienced observer, to decide whether an optic disk is normal as regards color, or unduly hyperæmic, or slightly anæmic, etc. An intimate acquaintance with the different shades of color observed in health, at different ages, and in eyes of different color, must assist us in the diagnosis.

The prognosis is uncertain, as long as the optic disk retains its natural pink color.

Such cases have been described as cases of reflex amblyopia, or of reflex amaurosis, if no morbid changes have been visible in the retina and in the optic disk.

The treatment, in great measure, depends upon the nature of the symptoms. The division of a nerve, which may be the source of spasm or of neuralgia, the removal of a carious tooth, complete exclusion from light for some weeks, general medical treatment adapted to the patient's constitution, etc., have, in many cases, rapidly succeeded in restoring or improving vision.

HYPERÆMIA OF THE RETINA.

The examination of numerous healthy eyes, the comparison of the two eyes (if this condition is confined to one eye), and the general appearance of the patient, are, in slight cases, the guide as to the existence of hyperæmia of the retina. An increase in the number both of arteries and of veins, with an unusual brilliancy of the retina and hyperæmia of the optic disk, is observed in hypermetropics, with asthenopia, and in myopics, with signs of irritation. Hyperæmia of the retina often appears during severe inflammation of other parts of the eye, and occasionally, in cases of protrusion of the eye, from extra-ocular causes.

Overfulness of the veins of the retina—venous hyperæmia—is observed in persons suffering from syphilis or albuminuria. It also precedes inflammation of the optic disk, and appears whenever the return of blood from the retina is impeded, through pressure upon the optic disk, or upon the optic nerve, inside or outside the eye.

The arteries generally appear thin and fewer in number, while the veins are large, tortuous, numerous, and most conspicuous in and near the optic disk.

Venous hyperæmia also precedes and accompanies inflammation of the retina.

RETINITIS (INFLAMMATION OF THE RETINA. DYCTITIS).

Retinitis is very rarely idiopathic. As a rule, it appears as one of the symptoms of other morbid changes, such as albuminuria, syphilis, cerebral tumors, etc.

Retinitis appears very frequently in both eyes simultaneously, though it may vary in degree: it most frequently occurs in the part of the retina which adjoins the optic disk, and in the portion which occupies the region of the yellow spot.

Peculiarities as regards color and shape or situation of the inflamed portion have given rise to the distinction of various forms of retinitis. These forms, if duly developed, are sufficiently characteristic to allow of recognizing the general morbid change, of which the retinitis is a symptom.

FORMS OF RETINITIS.

To facilitate reference, we will number the different forms.

(1.) *Retinitis, extending from the optic disk over a varying area of the retina.*

The retina, together with the entire optic disk, or with a part of it, appears hazy, gray, or gray-white and opaque. A similar change may simultaneously be found in the region of the yellow spot. The arteries appear thin and fewer in number. The veins are tortuous, gorged (pale-red in the leucæmic form, dark-red in the form which complicates cerebral tumors). (See *Inflammation of the Optic Disk.*)

(2.) *Retinitis apoplectica.*

An unusually large number of blood-spots (many of which lie close to gorged tortuous bloodvessels) appear in the turbid retina, especially at and near the optic disk

(3.) *Retinitis, with yellow or buff or crust-colored spots, or patches.*

This form of retinitis appears, by preference, in the region of the yellow spot, and round the optic disk, and is generally accompanied by marked decrease of blood-supply to the retina.

(4.) *Retinitis pigmentosa.*

(5.) *Retinitis, with one or several large, gray, and opaque patches.*

This form of retinitis occurs more frequently at some distance from the optic disk, or near the ora serrata. Small blood-spots, with increase in the number of arteries and of veins (which are particularly conspicuous in the optic disk), are observed in the retina; the retina adjoining the inflamed portion is œdematous.

The vessels, in the further course of the disease, gradually resume their natural calibre, though overfulness of the veins often continues long after the retina has resumed its transparency. The blood-spots and the opaque patches disappear, the retina gradually becomes transparent, and the choroid becomes visible. Some atrophy of the retina, with slight anæmia of the optic disk, generally remains.

(6.) *Suppuration of the retina.*

The retina rapidly (in from 12 to 36 hours) becomes yellowish-white, opaque, and swollen, especially round the optic disk and in the region of the yellow spot; where its thickness may be three or four times that of the retina in health. This swelling and the loss of transparency are caused by the pressure of pus-cells, exudation corpuscles, etc. The pus-cells and the exudation corpuscles are supposed to originate in the nuclei of the fibres of the framework of the retina.

The outer surface of the suppurating retina, in many instances, has a uniform red color, from the extreme capillary vascularity developed in it.

Causes and General Remarks.—1. Retinitis (5) has been observed after sudden exposure of the retina to bright light, and after undue prolonged exertion. The retinitis, in these cases, is often confined to the injured eye, and more often to the region of the yellow spot.

2. Retinitis (5) and (6) occur after injuries and operations. (See *Ophthalmitis.*)

3. Retinitis (5) and (6) often appear after general illness, such as scarlatina, measles, small-pox, etc., or during pregnancy, suckling, etc.

4. Embolism, albuminuria, diabetes, diseases of the heart and arteries, frequently give rise to retinitis (1), (2), or (3).

5. Syphilis gives rise to retinitis (1) or (3).

6. Intra-ocular causes of retinitis are choroiditis, inflammation of the optic disk, cyclitis, rupture of bloodvessels ("retinitis apoplectica"), tumors, and entozoa. These causes generally lead to retinitis (5) or (6).

Retinitis, with much loss of transparency of the retina, is often followed by atrophy. The retinitis may remain stationary, or may decrease (according to the habits, occupation, etc., of the patient); or it may progress rapidly to a certain point, and then become chronic. The longer the duration, the less favorable is the prognosis. Retinitis is frequently accompanied by choroiditis.

Symptoms common to all or to several of the above forms of retinitis:—

1. Loss of transparency, varying from slight haziness to a uniform gray and opaque color.

In the opaque portion we find blood-spots, or yellow and opaque spots (as in albuminuria), or rusty-colored, or yellowish-white, nodules (as in syphilis). The lesions of transparency are most conspicuous in the region of the yellow spot and round the optic disk; and, together with anomalies in the circulation, are characteristic of retinitis.

2. Alterations in the appearance of the bloodvessels.

In most forms of retinitis we find an apparent decrease in the number and size of the arteries, and a gorged, tortuous condition of the veins. Portions of these latter are entirely, or more or less, hidden in the opaque retina.

Groups of enlarged capillaries, appearing to the naked eye as blood-spots, are particularly frequent in the retinitis (5) and (6) covering the outer (choroidal) surface of the retina. Blood-spots, the result of rupture of bloodvessels, occur in most forms, but more particularly in (1) and (2).

3. Photophobia, photopsia, chromopsia, with headache, pain

in the eye, and with lachrymation, may appear in the beginning or in the further course of the disease, or may be entirely missing; or only one, or several of these symptoms, may be present.

4. The exterior of the eye (the eyelids, conjunctiva, cornea, etc.) presents nothing characteristic of retinitis. In suppuration of the retina, we generally observe those changes which appear during ophthalmitis, or chemosis, swelling of the eyelids, protrusion of the eye from œdema, or inflammation of the parts within the orbit, etc.

5. Vision. No impairment of vision may be observed by the patient if the inflammation occupies only peripheral parts of the retina, or if it is confined to one eye only, or if the occupation of the patient does not require acute sight.

We often find entire loss of transparency of the retina, with very slight impairment of vision, probably because the changes are, in that stage, confined chiefly to the connective tissue of the retina.

In slight degrees, or at the outset (when the inflammation occupies the region of the yellow spot or of the optic disk), objects appear to tremble, or glitter, or seen distorted, or surrounded by a gray-white, or brownish, or yellowish, or red, mist. Much light is required for vision, and objects have to be held closer.

In higher degrees, interruption or limitation of the field of vision is observed. Vision may become reduced to bare perception of light rather suddenly, and then decrease or improve gradually.

The impaired portions of retina are generally ill-defined. They are described as black or gray patches, by the patient, when looking at a sheet of white paper, held close to the affected eye.

The prognosis, as regards recovery of vision, is less favorable if there is interruption or limitation of the sensibility of the retina, than if the entire retina is more uniformly impaired. The longer the duration of the retinitis, the worse the prognosis. Dark spots in the field of vision may clear up in some parts more than in others, or may disappear entirely.

Treatment.—For the treatment of the forms of retinitis (1), (2), (3), and (4), see articles on the several subjects.

Treatment of form (5).

Both eyes must be kept thoroughly at rest, until all hyperæmia has disappeared from the retina and optic disk. This is effected—

1st. By keeping the lids of both eyes closed during the day, if there is intolerance of light: we simply prohibit the use of the eyes for near work, if there is no intolerance.

2d. By ordering atropia to be applied, twice daily, and tinted spectacles to be used, if the atropia should give rise to intolerance of light.

3d. By avoiding everything that might derange the circulation in the retina, such as travelling in a carriage, stooping, occupations causing excitement, etc.

4th. By bathing the closed eyelids with cold or warm water, according to the liking of the patient, and as often and as long as it is pleasant.

One or two leeches to the temple, on the side of the affected eye, applied at bedtime, relieve pain, if it be accompanied by such hyperæmia of the inflamed part.

The retina and optic disk should occasionally be examined with the ophthalmoscope. A glance will suffice to ascertain their condition. When once the retina has become transparent, and the choroid again visible, little further improvement of vision can be expected.

The general hygienic and medical treatment must be directed according to the cause of the retinitis, and the health of the patient.

Mercury has been found of use in retinitis, occurring during pregnancy. Tonic treatment is adopted when the retinitis has appeared during or after small-pox, measles, and similar weakening diseases. This form of retinitis, in weak persons, often goes on into suppuration. (See, also, *The Treatment of Choroiditis.*)

ATROPHY OF THE RETINA.

The cause of the atrophy, in a great measure, determines the kind; and, again, the different kinds point to different causes. With the ophthalmoscope, and on a minute examination, we can distinguish four different forms:—

No. 1. No morbid changes are perceptible in the choroid, nor in the transparent retina, beyond an extreme anæmia of both tunics, or of the retina only.

Anæmia of the choroid (the groups of the stellate pigment cells being visible throughout the choroid) may be mistaken for atrophy of that tunic, by those who are not familiar with the color and shape of these groups in health.

The retinal arteries and veins are thinner the farther they are from the optic disk. They are tortuous and unequally dilated, the optic is anæmic, or anæmic and atrophic. It has a waxy-white and opaque color.

No. 2. This form is described as one of the sequels of inflammation of the optic disk. It is the conjoined result of an impeded blood-supply to the retina, and of impaired nutrition, through arrest of the function of the optic nerve. (See *Inflammation of the Optic Disk.*)

No. 3. Atrophy following retinitis or choroido-retinitis. The optic disk may be anæmic or atrophic, or highly hyperæmic. Its margin, according to the changes in the choroid and retina, is either well-dilated, or its color merges into that of the tunics.

Causes and General Remarks.—Atrophy of the entire retina, or of portions of it, the result of old age, is very rarely observed to such an extent as to be regarded as morbid. In the few cases which have occurred, the appearances were those described as "retinitis pigmentosa."

The following changes lead to atrophy of the retina:—

1. Any of the lesions which, for a long time, prevent retinal impressions from reaching the brain, such as diseases of the brain or of the optic nerves. The atrophic changes described as for No. 1, in these cases, appear late, and progress very slowly.

A certain amount of atrophy may disappear again, if the extra-ocular lesion subsides.

2. All changes which mechanically cause anæmia of the retina, such as embolism, inflammation of the optic disk, cupping of the optic disk, increase of tension.

3. A large series of intra-ocular changes, which may be separated into—(*a.*) Those which commence in the choroid, leading to atrophy of that tunic, and, secondarily, to atrophy of the retina; or which, during choroiditis, invade the retina, destroying it from its outer surface (form No. 3); and (*b.*) Those which commence in the retina, subsequently to retinitis (form No. 3), or which are caused by pressure of the contents of the vitreous chamber upon the retina, destroying the latter from its inner surface (form No. 2).

RETINITIS DURING ALBUMINURIA.

Retinitis may appear whenever albumen is present in the urine: it is most frequently observed in patients suffering from Bright's disease. Retinitis, in these cases, has been considered a forerunner of albuminuria. On careful examination, however, it will be found that alterations in the kidneys have existed long before, though the symptoms may have been so slight, or progressing so slowly, that the retinitis has become the first prominent symptom of the kidney-disease.

When meeting with this form of retinitis, we must be prepared to see other uræmic symptoms make their appearance, though they need not necessarily follow.

"Granular kidneys," with dilation of the cavities of the heart, and with hypertrophy of the left ventricle, have been found, not in all, but in most cases in which *post mortem* examination could be obtained.

The opacity and swelling of the retina, and the tortuosity and enlargement of its veins, disappear gradually. The outline of the optic disk becomes visible again, together with the vessels in it. We may find the yellow spots, which appear in the later stage of the retinitis, alone, or mixed with blood-spots, while the rest of the retina has regained its transparency.

Peculiar changes, by some described as "sclerosis," have been found in the coats of the bloodvessels, especially in those of the small arteries, and of the capillaries of the retina and of the choroid. These vessels have appeared unusually tortuous and flattened in many places, with their walls thickened by a homogeneous, strongly light-reflecting "amyloid," not quite transparent, substance. In some cases the thickening of the walls has caused occlusion of the lumen of the vessels. This may have been the cause of the small aneurismata, which have been found in many parts of the capillaries.

The retina and choroid, adjoining the thickened vessels, in some cases, appeared hypertrophied.

The yellow or buff-colored spots, when situated in the retina itself, were found amongst its ganglion cells, but more frequently in the granule layers. The spots were most numerous round the yellow spot. The thickness of the retina, as could best be seen in sections, was considerably increased.

Treatment.—The general medical treatment is that of albuminuria. Much benefit is derived from large doses of strychnine, combined with steel; and, in stout nervous persons, from a combination of Mixt. Ferri Co. and Decoct. Aloës Co., āā ℥j., to be taken at bedtime.

No advantage has yet been gained from surgical treatment, such as iridectomy, etc. Rather abundant local depletion (*e.g.*, by applying from six to eight leeches to the corresponding temple) is found of great use in the commencement of retinitis, but is injurious when once the yellow patches have appeared. If these spots and patches are numerous in the retina, or if blood has been effused into the vitreous chamber, atropia should be applied, twice daily; and the eyelids should be kept closed by a bandage, if one eye is affected, or a shade should be worn, if both eyes are attacked.

The local treatment is discontinued as soon as the yellow patches have disappeared. Displacement of the retina, following extensive hemorrhage, or destruction of the retina, through atrophy, etc., is the frequent cause of permanently impaired vision.

The prognosis, as regards recovery of vision, is good, if there are but few spots of the retina affected. An improvement may be expected as long as yellow or blood-spots are visible.

DISPLACEMENT OF THE RETINA.

Displacement of the retina, if it commences without pain or outward inflammation, may escape notice for some time, until the patient accidentally discovers the sight is failing. Some patients state, that when the eye began to fail, they suddenly found they could only see the halves of objects, or that a black, well-defined cloud (sometimes appearing, at first, red, then yellow) obscured some, and generally the upper parts of objects. Objects, at the outset of the displacement, often appear crooked, bent, or multiplied, or as if surrounded by red haze. The changes, in many cases, especially if following an injury of the tunics of the ciliary region, may be preceded, for years, by muscæ, or by some "dimness." In some cases the muscæ appear suddenly, and the displacement shortly follows.

Severe throbbing pain in the eye and temple, fiery circles, stars suddenly appearing and disappearing, may precede the displacement, for weeks. Some patients state, that after bodily exertion, a flash of light passing across the eye has been followed by sudden impairment of vision.

Owing to changes in the retina adjoining the displaced portion, the impairment of vision is often more considerable than might be expected from the extent of the displacement, especially in fresh cases. The transition from the blind to the normal parts of the retina is gradual, if the displacement is small; it is sudden, if large portions of retina are displaced.

The greater part of the retina may be displaced, and the patient may still be able to read small type, if the region of the yellow spot has remained intact; or all perception of objects may be abolished, if the retina round the optic disk has been displaced, though there still be a large eccentric portion in its proper position. The upper or the lower parts, only, of an object are perceived, if the upper or lower half of the retina is alone displaced. In a few cases of complete displacement of the retina, the power of perceiving light has been retained.

Secondary changes often destroy the sensibility of portions of retina which are not displaced.

Vision may become much improved after the changes in the retina next to the displaced portion, and those in the vitreous chamber, have subsided. The fluid between retina and choroid often becomes less, or alters its position; and the sensitive parts of the retina are thus excluded from vision. It not unfrequently happens that the displacement is complicated with effusion of blood into the vitreous chamber, or with cataract; in such cases the retina may not be accessible to ophthalmoscopic examination.

Cataract generally appears two or three years after displacement of a considerable portion (generally the lower half) of the retina: it is particularly necessary, in such cases, to recognize the presence of displacement, by testing the sensibility of the retina. For this purpose, the patient is placed in a dark room. The healthy eye kept closed, the flame of a candle is moved before the suspected eye, or reflected upon it with the ophthalmoscope. The flame can be perceived only by sensitive portions of the retina. Suppose the lower half of the retina to be displaced, we shall find that if the flame be held opposite to it (that is, above the level of the pupil), the patient cannot perceive the flame, and if requested to indicate with his hand the position of the flame, he cannot do so. In cases of cataract, this is conclusive. In effusion of blood into the vitreous chamber, a doubt remains as long as the blood is accumulated at the most depending part, thus preventing the light from reaching the retina.

Treatment.—Spontaneous "absorption" of the fluid between retina and choroid (in part, or *in toto*) has frequently been observed. This occurs sometimes with unusual rapidity. The retina comes again in contact with the choroid, but does not resume its functions. If the displacement is limited, and the displaced retina transparent, or nearly so, and the patient is otherwise in good health, from six to twelve leeches should be applied to the temple of the affected side, at bedtime; after which both eyes must be kept closed for two or three days, and the patient must remain in bed. The improvement, in some cases, is very great after repeated leeching. Patients with bare perception of shadows have been able, after the second leeching, to read large letters. In some, however, effusion of blood has occurred, between the choroid and retina, after the leeching; in others no improvement has followed.

No treatment restores even perception of light, if the entire retina is displaced.

The local application of atropia, though it may not affect improvement of vision, seems to retard further displacement. Atropia should be used sufficiently frequently to keep the ciliary muscle of the affected eye at rest.

No treatment seems of use—

(1.) If the entire retina is displaced, or if the displaced retina has lost its transparency, or if there exists atrophy of the rest of the retina and of the optic disk.

(2.) If the displacement has occurred in the course of ophthalmitis, or if suppuration of the retina, or if suppuration of the vitreous substance, within the area of the retina, has set in.

(3.) If the displacement is a complication of intra-ocular tumors.

In the two latter cases excision of the eyeball may have to be performed.

Myopic persons are the only subjects in whom the displacement has hitherto been observed in both eyes. It is in myopia that photopsia and hemorrhage into the vitreous chamber most frequently precede the displacement. A diffused red color, appearing suddenly in the interior of a myopic eye (viewed with the ophthalmoscope), so that no distinct view can be obtained of the optic disk and of the tunics, has been observed as a symptom of commencing displacement ("of loosening") of the retina.

The displaced retina occasionally becomes ruptured spontaneously, and the fluid between it and the choroid escapes into the vitreous chamber, while the retina resumes its position upon the choroid. This has led to the operation of perforating the displaced retina. No serious accidents have followed, in the cases hitherto operated upon.

The earlier the operation is performed, the greater is the improvement of vision that may be obtained. This, sometimes, is almost immediate, or appears a few days later.

Signs of the success of the operation are:—disappearing or diminution of the displacement; turbidity of the previously transparent vitreous substance; improved sensibility of the peripheral parts of the retina. Immediately before performing the operation, we should ascertain the degree of impairment of vision, and the extent and position of the displacement.

Operation.—The patient is seated as for ophthalmoscopic examination; the eyelids are kept open by the wire-speculum; and the eyeball is fixed by an assistant. The operator uses the ophthalmoscope with the left hand; and having, by "direct" examination, obtained a view of the prominent portion of the displaced retina, thrusts a cataract-needle, of sufficient length, through the tunics into the vitreous chamber, at the spot which seems most suitable. The operator watches, with the ophthalmoscope, the passage of the needle across the vitreous chamber, and through the displaced retina into the space between it and the choroid. Having thrust the needle through the displaced retina, he gives the ophthalmoscope to an assistant, who, with it, throws light upon the eyeball. The operator then passes through the tunics a second needle, about the third of an inch from the first one, carrying it, as nearly as possible, to the spot where the first one has passed through the displaced retina. After having brought the second needle in contact with the first, the operator thrusts the former on, still, a little farther (about to the same extent as the first needle). The points of the two needles are now supposed to be in the space between the choroid and displaced retina, their stems crossing each other.

The object of the next manœuvre is to tear a hole in the displaced retina. This is accomplished by approaching the handles of the needles towards each other (without withdrawing them, or pushing them further into the eye, and without making the movements so extensive as to cause the points to touch the portion of the retina not displaced). Having manipulated with the needles in such a manner as to make the existence of a rent in the displaced retina probable, one needle is withdrawn, and the ophthalmoscope is again used, to ascertain, if possible, the effect of the operation.

If the previously transparent vitreous substance is now turbid, or a rent is visible in the retina, or if flocculi of retina are seen projecting from the displaced portion, the second needle is also withdrawn. The manipulation with the two needles should be repeated, if no alteration has occurred in the appearance of the displaced retina. The patient is put in bed, and the eyelids of both eyes are kept closed for a few days. Experience, as regards the kind of cases in which the operation should be recommended, and the final results, is too limited to enable us to establish any rules.

The prognosis of displaced retina is, under all circumstances, very gloomy, and justifies our recommending an operative treatment, which, in several of the cases in which it has been adopted, has had favorable results.

An eye, with displacement of a small portion of the retina, between the yellow spot and the optic disk, and with divergent strabismus, was operated upon for the strabismus. A few weeks after the operation, the vessels in the displaced portion of the retina resumed their natural course, and vision became much improved.

PROTRUSION OF THE EYEBALL.

(Exophthalmos=protrusion of one or both eyes through—generally acute—inflammation within the orbit, or of the orbit and eyeball. Hydrophthalmos=protrusion of one or both eyes through distention of the tunics of the eyeball, especially by fluid, and without real change of place of the enlarged eye. Ophthalmoptosis=protrusion through paralysis or paresis of the muscles. Luxation of the eye=sudden protrusion through injury. Evulsion of the eye=sudden protrusion by injury; the eyeball being more or less torn away from its appendages.)

Protrusion of the eye, if it interferes with the functions of the retina or optic disk, gives rise to impairment or loss of vision. Anomalies in the functions of the fifth nerve (pain, anæsthesia), or paresis or paralysis from changes in the third, fourth, or sixth nerve, may arise, with or without derangement of the circulation and nutrition of the eye.

If adjoining cavities are implicated, an additional series of symptoms appear, which may be due to tumors in these cavities.

Rapidity of Appearance.—Protrusion occurs suddenly during and after hemorrhage behind the eyeball, and in some cases of aneurism. In a few cases of aneurism, it has appeared gradually, but has increased rapidly.

It has occurred within a few days after simultaneous paralysis of the third, fourth, and sixth nerves. Slight pressure upon the eyeball made it disappear.

A rapid succession of the signs of tumors in the orbit, with outward inflammation, may lead us to suspect the presence of an abscess, especially if fluctuation is felt somewhere between the eyeball and the margin of the orbit.

Of tumors which are accompanied by gradual protrusion, the bony tumors are the slowest, the cancerous ones the most rapid, in their progress.

Mobility of the eyeball, and increase and direction of the protrusion.

Increase of the protrusion indicates an increase of the morbid changes behind the eye, or their extension towards it. If situated in front of the equator of the eyeball, they may spread between it and the walls of the orbit, push forwards the conjunctiva and the lids, impair the movements of the eyeball, and yet hardly displace it; while, if situated behind the equator, protrusion always appears.

The eyeball becomes displaced outwards and downwards, or outwards and upwards, through changes in the frontal sinuses. Through enlargement of the lachrymal gland, it may be displaced inwards and downwards. The direction of the displacement of the eyeball varies, if caused by changes at the apex of the orbit, according to which wall of that cavity is most implicated; if, *e.g.*, it be pushed downwards and forwards, we suspect the apex of the orbit and its upper wall to be most at fault.

The amount of protrusion is not proportionate to the size of the tumor, etc., which may cause it. A tumor may fill out the adjoining cavities, and encroach but little upon the orbit. The protrusion, when caused by disturbances in the circulation, increases on stooping, or increases and decreases spontaneously, or may be arrested, or otherwise influenced by compressing the carotid artery of the corresponding side. The protrusion may be increased by the action of the orbicularis muscle—the expanded fibres of which, when closing the lids, may press upon the protruding tissue, between the margin of the orbit and the eyeball, and, through this, upon the eyeball, behind its equator.

The more the eye is pushed forwards the more its mobility is decreased. Its movements may be impaired in one or two directions, particularly if the cause of protrusion is confined to one side of the orbit, as in tumors, caries, etc. They may be impeded in all directions equally—as, for instance, in struma, and in hypertrophy of the orbital tissue. A mobility in all directions, however impeded, shows that the eyeball is not adherent to the walls of the orbit. The movements may remain impeded in all directions, or may be destroyed; or the eyeball may become fixed in a certain position after the protrusion has subsided.

Changes of the Protruded Eye and of its Appendages.—The lids readily become floccid, if expanded over a large or protruding eyeball, and by accident, or during manipulation, the margin of either lid may slip back over the eye. A bent probe, passed beneath the displaced lid, readily succeeds in lifting it forwards. Œdema, drooping and redness of the lids, and œdema, chemosis, and enlargement of the vessels of the conjunctiva, occur in rapid or considerable protrusion. Vascularity of the conjunctiva, in one particular part, may be a guide as to the situation of the cause. As soon as the protrusion is so considerable that the cornea is no longer protected, the destruction of the eye may be expected. Anæsthesia of the cornea frequently occurs even in moderate degrees of protrusion. The cornea and the conjunctiva of young people may remain exposed to the air, etc., without injury, for a longer time than those of the aged. The state of nutrition and health of the cornea, previous to the protrusion, materially influence its power of resistance to exposure. Cases of struma and of cancer have occurred in which power the protruding cornea suppurated or sloughed. In a case of hemorrhage behind the eyeball, in a young man, the cornea sloughed within 36 hours after the commencement of the extreme protrusion. The cornea having become perforated, the contents of the eye may escape, and the eyeball shrink; or the suppuration may extend, and ophthalmitis ensue. In some cases extreme protrusion may exist, for weeks, during an inflammation of the deeper parts of the orbit, and yet, the protrusion subsiding, the eye may resume its functions, or, though apparently intact, may remain amblyopic or amaurotic. In other cases, ophthalmitis may appear even during moderate protrusion.

Vision.—Double vision is complained of when protrusion of an otherwise healthy eye occurs rapidly; especially is associated with lateral displacement. In every case, we should inquire for double vision, and also ask whether it came on suddenly, whether it has existed for a long time, and whether it is present in all directions, or in what direction of the eye it is most perceived. For instance, we suspect morbid changes at the roof of the orbit, if, on looking upwards, the patient observes double vision, with differences in the height and parallelism of objects. In slowly-progressing protrusion, double vision remains unobserved, or vision may have become too much impaired to make it perceptible.

An eye may protrude so much as to render it difficult for the lids to close over it, and yet, for months, the patient may be able to read well, and have otherwise what he terms good sight. In other cases of but slight protrusion, sight may be lost. In a case of aneurism of one ophthalmic artery, vision was lost long after the recovery from protrusion.

Patients complaining of "a black veil coming over the sight," or of "only seeing half an object," frequently suffer from displacement of part of the retina; an accident which accompanies most intra-ocular, and some of the extra-ocular tumors.

Visions of bright colors, flashes of light, falling of stars, are frequently complained of in congestion of, or pressure upon, a healthy optic nerve; for instance, in the course of melanotic tumors of the orbit.

Pain and Cerebral Symptoms.—Absence of pain is a favorable symptom. Pain felt when pressing upon the eyeball, or on the tumors, generally indicates periostitis. Pain in the head, at the back of the eyeball, coming on suddenly, has been observed in aneurisms, and in periostitis, at the apex of the orbit. Headache occurs frequently in protrusion from periostitis (especially if of syphilitic origin), or from impediments to the circulation of blood in the larger vessels.

Inflammation, originating in the tissue of the orbit, may extend into the brain, and cause meningitis, etc. Convulsions, epileptic fits, hemiplegia, impairment of the mental faculties, and paralysis of the first, second, and third nerves, have occurred when suppuration has extended from the orbit to the base of the brain. Brain symptoms, during inflammation in the orbit, and without paralysis of the first, second, or third nerves, indicate the probability of the presence of pus, between the dura mater and the bones, near the roof of the orbit, or in the anterior lobe of the brain. Loss of appetite, vomiting, increase of heat, increased frequency of pulse, shivering, sleeplessness, delirium, may occur after operations for protrusion, and indicate disturbance at the base of the brain. In a case recently operated on, in Dr. Walker's Infirmary (for enlargement of the right frontal sinus), with protrusion, hemiplegia and delirium appeared on the second day, and subsided a week after the operation, the patient recovering completely.

Causes of Protrusion in General.—Protrusion of both eyes is frequently observed in persons suffering from palpitations of the heart, with enlargement of the thyroid gland (struma). Accumulation of blood in the vessel of the orbit is the probable cause.

It has been observed in feeble, stout persons, generally females, from an undue accumulation of fat in the orbits (as found after death), with weakness of the muscles of the eyeball.

Protrusion durimg acute inflammation of both eyeballs, or of the tissue of both orbits, is very rare; so also is cancer in both eyeballs or orbits simultaneously. More frequently we observe protrusion of both eyes, as a complication of hydrophthalmia.

Protrusion of one eye, from inflammation within the orbit, has occurred during scarlatina, measles, variola, puerperal fever, and similar diseases, and most frequently during recovery. Also after injuries, during erysipelas, phlebitis, glanders, and tuberculosis, from inflammation of the lachrymal gland, from abscesses formed in adjoining cavities; for instance, in the cranium, or the frontal sinuses, and perforating a wall of the orbit. Acute inflammation of the soft parts of the orbit, or of its bones, or of the eyeball, constitute, as a rule, the immediate causes of the protrusion. Every ophthalmitis, especially if it occur quickly, as may happen after extraction of cataract, causes in itself protrusion, by implicating the soft parts of the orbit.

Considerable protrusion, without external inflammation, may be caused by tumors, for instance—bony new growths, cysts, or aneurisms; by paralysis of the third, fourth, or sixth nerves; by hemorrhage behind the eyeball, occurring spontaneously, or after an illness; by accumulation of serum between the eyeball and Tenon's capsule (in a case of this kind, it increased on stooping, and then occasioned pain; the eye was subsequently excised); by enlargement of the nasal cavities, of the frontal sinuses, or of the antrum.

General Remarks on Treatment.—Great similarity often exists between the external symptoms of protrusion from different causes; and, in many instances, the line of treatment remains uncertain until we have reached the cause—tumors, etc.—with the knife. This is particularly the case if inflammation of the soft parts of the orbit, or of the eyelid, complicate deep-seated tumors. In every case of protrusion, we compare the thickness, position, etc., of the margins of the two orbits, and, if possible, pass the finger into the for. ix of the conjunctiva, between the walls of the orbit and the eyeball, to ascertain the elasticity, consistence, fluctuation, etc., of a deep-seated cause of protrusion.

By directing the patient to turn the eye in various directions, to bring into view the curvature of the sclerotic, we ascertain the shape of the eyeball, and how much of the protrusion is due to enlargement of the eye, and also whether the sclerotic is adherent to whatever may cause the protrusion, and whether the functions of the recti or oblique muscles are impaired.

Other means of diagnosis are, auscultation of the margin of the orbit, ophthalmoscopic examination, and a careful scrutiny of the cavities adjoining the orbit.

The operation of removal of a tumor is indicated, if the tumor increases in spite of medical treatment; if the eyeball or the brain is in danger; if a permanent disfigurement is eminent, especially if the eye can be saved.

Cases of removal of large tumors from the orbit, in which vision has been preserved, are numerous. Whether the eye be lost or not, we adopt that mode of operating which, with complete removal, gives the best result as regards personal appearance. The operation is the more difficult the longer it is postponed, if the tumor grows rapidly. Tumors which grow slowly and without pain, which are well-defined, where the eyelids are not implicated, and where the patient's health is good, are, as a rule, of a non-malignant character. The size, situation, and especially the nature of the tumor, whether cancer or not, influence our prognosis. If the nature of the tumor is not known, and its complete removal necessary, then, for want of space, we may be obliged to remove the eyeball. The removal of bony tumors may take hours. Cases of this kind have occurred in which the attempt at removal had to be discontinued, on account of the difficulties met with during the operation. Before proceeding to the removal, an exploring trocar may be passed into the tumor, along the wall of the orbit which gives the easiest access to it, unless there be symptoms of aneurism.

For the removal of bony tumors, we require the instruments used in other parts of the body for similar purposes, or gouges, chisels, etc., of different sizes. It may be necessary to keep the patient under the influence of chloroform for an hour or more. If we determine upon the removal of the eyeball, this part of the operation should be done first; the tumor may thus be rendered more accessible.

The incision through the skin and the soft parts is carried over the most prominent part of the tumor, and parallel with the margin of the orbit. A large tumor may require a second incision, meeting the first at right angles. The surface of the tumor, once freely exposed, if of bony nature, is seized with the forceps, and sometimes may be broken off from its attachment.

With the saw, gouges, chisels, etc., we may have to work round its base to detach it. Diseased bone, near the tumor, should be removed. Bruising of the eyeball must be avoided as carefully as possible. A soft tumor or a cyst must be freely exposed, in order to reach the base or pedicle.

After the operation, we facilitate free escape of pus, etc., and adhere to the general rules for the treatment of inflammation of the orbit.

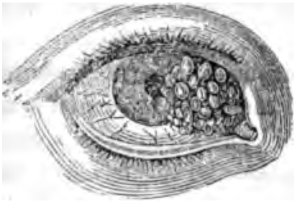
No secondary operations for the correction of changes in the position of the eyelids or eyeball, etc., need be performed until the effects of the first operation (swelling, redness, tenderness, discharge, etc.) have completely subsided.

For further particulars, see the treatment of the special causes of protrusion.

TUMORS OF THE ORBIT, OR OF THE EYEBALL, OR OF BOTH.

Tumors may cause protrusion of the eyeball, whether they be situated within the eye, or in the orbit, or in the cavities adjoining the latter (the frontal sinuses, the antrum, and the nasal cavities). They may appear simultaneously in several of these localities; or they may secondarily cause inflammation, etc., of the soft parts within the orbit.

Cancer.—The growth, as in other parts of the body, consists of a variable quantity of connective tissue, bloodvessels, or interstices filled with blood, brown or black pigment in varying proportion, and cancer-cells. Portions of the growth may be of a brown color ("mixed melanotic and medullary cancer"), or have the consistence and somewhat the color of brain substance ("pure medullary cancer"), while other portions are of fibrous hardness. Sudden transitions of color or consistence may appear in some parts, gradual transition in others. In the melanotic form, the cells and fibres are loaded with brownish or black pigment granules, and with amorphous black matter. The cancer-cells of cancerous growth, in the orbit or eyeball, differ, in most respects, from those found elsewhere.



(Fig. 36.)

The medullary and melanotic forms of cancer have been primarily in all parts of the orbit and eyeball, *e.g.*, upon the cornea, upon the outer surface of the sclerotic, near the optic nerve,—attached to the inner surface of the sclerotic, and passing through the choroid and retina into the vitreous chamber,—and in the ciliary muscle.

In the retina the medullary, and in the choroid the melanotic, forms seem to occur primarily most frequently.

Cancer may appear simultaneously in different parts of the orbit and eyeball. It may cause inflammation of the adjoining tissues, or it may extend into them by infiltration, and thus frequently appear as a "tumor". It seems especially prone to extend along the course of the veins; it may fill the eyeball (sclerotic), destroying all its contents, long before appearing elsewhere; it may show itself upon the outer surface of the sclerotic, soon after its appearance within the eye.

Increased vascularity of the conjunctiva, displacement of the iris, paralysis of the pupil, swelling, with loss of transparency of the lens, enlargement of the ciliary veins, and swelling of the sclerotic, with bulging of the latter, may precede the extension of cancer from the interior of the eye; while, in other cases, hardly any irritation occurs, during extensive development of cancerous tissue, within and around the eyeball.

Destruction of the iris, suppuration or sloughing of the cornea, with protrusion of cancer, occur but rarely; this may, however, happen from whatever part of the anterior of the eye the cancer may have originated.

Cancer in the choroid is most frequently of the melanotic kind, and originates in the part of the choroid occupied by the large veins (vasa vorticosa). Its favorable seat is the region of the yellow spot. It may appear as a defined tumor, or in the form of diffuse infiltration, or as both. Traces of the elastic lamina, generally covered with colloid globules, swollen, roundish (changed hexagonal) cells, with enlarged nuclei, and with only a few or no pigment granules, may be found on the surface of the new growth; while its base rests among the stellate pigment cells of the choroid.

The secondary changes, usually found in the other tunics of the eye, are: destruction of the vitreous substance (by pressure), and partial or total displacement of the retina.

Every cancer which springs from the sclerotic or choroid, and projects into the vitreous chamber, within the area of the retina, causes changes in the position of the latter. Thus the retina may become adherent to the tumor, or its curvature may undergo alteration, in consequence of its being pushed into the vitreous chamber; or it may be completely detached from the choroid by an accumulation of fluid. This fluid, which is highly albuminous, may be clear or mixed with blood, cancer-cells, or pus; its effusion is supposed by some to be caused by pressure of the tumor upon the veins of the choroid.

A very small tumor may be accompanied by displacement of the entire retina by fluid; while a large tumor may merely detach that part which passes over its surface. The same applies to the vitreous substance, which does not disappear in proportion to the size of the tumor, nor to the rapidity of its growth. A small tumor, together with fluid effused between the choroid and retina, may cause all "the vitreous" to disappear; while some "vitreous" may remain by the side of a tumor which occupies the greater part of the interior of the eyeball.

Displacement of the retina may precede, for some time, and frequently marks, the appearance of a tumor in the choroid. Complete displacement of the retina, with increase of tension, indicates the probable existence of a tumor within the eyeball. In such cases, a part of the retina is in apposition with the lens, and is thence reflected towards its insertion along the ora serrata. This indicates great pressure upon the outer surface of the retina by the fluid between it and the choroid.

Other secondary changes are: destruction of the retina, cataract, iritis, sloughing of the cornea, etc., etc. Such changes may not appear until years after the loss of vision. In one case eight years elapsed. In the case of a patient, aged 50, "five years ago, a black cloud was observed rising from the lower part of the eye, and obscuring the upper halves of objects;" displacement of the retina was thus indicated: sight was entirely lost in three months after the first appearance of the cloud. The eye was not otherwise troublesome, until five months ago, when it began to shrink (instead of becoming perforated, as is usual in cancer) and to become painful. It was excised. The interior was found occupied by a hard, black (melanotic) mass, firmly adherent to the sclerotic, and consisting of a dense network of fibrous tissue, loaded with brown pigment granules and amorphous black pigment. Traces of choroid, and a "chalky" crystalline lens, were found; but neither vitreous nor retina. Such a course of melanotic growth in the choroid is very unusual.

Cancer in the Retina and Optic Nerve.—In one case the growth appeared primarily in the retina, in the shape of grayish-white and opaque nodules; some of which were ill-defined, and seemed to originate in the layers of the retina adjoining the optic nerve-fibres. The outer surface of retina was not adherent to the choroid.

In several cases cancer has been observed primarily in the optic nerve, and, by preference, at the sclerotic aperture, and at the optic foramen. The medullary form, with a moderate amount of connective tissue, is the most frequent. It may give rise to great protrusion, without involving the organ itself; or it may encroach considerably upon the brain, without sensibly disturbing the cerebral functions.

Vision.—The accounts given by patients suffering from intraocular tumors, as to loss or impairment of vision, vary.

Many find, accidentally, that "the sight of the eye is lost," or are led to examine the state of vision, by some peculiarity in the appearance of the eye. Some state, that "the eye has been blind for years, and has only lately commenced to be troublesome." Muscæ and flashes of light are rarely observed. A mist intervening between objects and the eye, and gradually becoming thicker, is often complained of. Some, at first, notice that objects can be perceived, only, when held in certain positions. The perception of a black cloud, which seems to rise "from the lower part of the eye," and obscure the upper halves of objects, is very common; the cloud rises higher and higher, and finally destroys sight. This symptom must be referred to displacement of the retina, preceding or accompanying the growth of a tumor.

Diagnosis and Cause.—If the lens is transparent, we may after, with the ophthalmoscope, obtain a view of the tumor. In a patient, aged 26, a tumor (medullary cancer), projecting from the upper equatorial region of the tunics of the eye into the vitreous chamber, presented the following appearances:—close behind the lens was seen a rounded, well-defined substance, about the size of a large pea, and of a waxy-white color. It had no independent movement. Its summit stood about opposite the posterior pole of the lens, and both sides and summit were overrun by bloodvessels belonging to the retina. Some, coming from the optic disk, could be traced round the sides of the tumor; while others, disappearing behind it, reappeared on the summit. Gray and opaque flocculi were observed floating in the vitreous chamber, near the tumor. From the transparency of the retina and choroid, immediately round the base, it was inferred that these tunics were in their normal positions, at that part.

Displaced portions of retina, if opaque, mark a tumor of the choroid or sclerotic. In this case, an increase of tension of the eye, attacks of ophthalmia, with pain, paralysis, and dilation of the pupil, with displacement of the lens forwards, make the presence of intra-ocular tumors very probable. We must not neglect to ascertain the mobility of the eye and the curvature of the sclerotic.

The diagnosis is more difficult if the lens is opaque, and vision impaired or lost. The mode in which vision has been lost, the general health of the patient, the family history, and such points as are taken into consideration in cases of tumors elsewhere, have to be inquired into. If there is no pain and no perception of light, we may be obliged to wait before expressing an opinion. Melanotic cancer, when appearing upon the outer surface of the sclerotic, may be mistaken for staphyloma of the sclerotic, unless the ophthalmoscope be used, when the semi-transparency of the staphyloma will decide the question.

Cancer, as a rule, increases much more slowly when confined to the interior of the eyeball. Ten years or more may elapse, in grown persons, from the first symptoms of cancer in the eye to its becoming fatal. Ill-health, more than anything else, seems to favor its increase. Pain is rarely absent throughout its course; paroxysms may occur at any time. Attacks of "ophthalmia," as a rule, occur after vision is lost; they have a glaucomatous character, being accompanied by increase of tension. After a certain stage is reached, the neighboring glands may become infiltrated.

Patients may die from the effects of fever, from general emaciation, from loss of blood or pus, or from the effects of cancer in other organs.

Treatment.—Respecting the advisability of excision of the eyeball, or of removal of a cancerous growth from the orbit, opinions vary. Some think that if the general health is supported and no operation performed, the patient lives longer than if operated upon. The experience of those who advocate an operation is, that melanotic cancer returns sooner than any other form, and that cancer originating in the retina or optic nerve, though the orbit be not implicated, is likely to return sooner than when springing from other parts of the eye or orbit.

An operation is thought not advisable (*a*) if the total removal of the cancer be impossible (the eyeball immovable and adherent to the orbit); (*b*) if the glands near it be swollen (this swelling being referable to the cancer); (*c*) if the cancer have existed for a considerable time, and have lately been increasing rapidly.

The increase of pain and tension has, in some cases, been temporarily arrested by iridectomy.

Complications of cataract with cancer are not uncommon. We must be guided in the diagnosis by careful examination of the sensibility of the different parts of the retina, of the tension of the eye, and by the state of health preceding the appearance of cataract. The presence of cancer renders the removal of the cataract useless.

Excision of the eyeball, or tumor, if decided upon, should be performed as soon as possible. If the patient's general health is good, especially if he is young, and if the cancer is confined to the interior of the eye, there is the greatest probability that the return of the cancer will be tardy.

STRUMOUS DEPOSIT.

Choroiditis Hyperplastica.—A yellowish and opaque, sometimes brilliant metallic reflection from behind the pupil, most frequently observed in children, is, by many, considered as characteristic of cancer. Displaced retina alone, however, with or without chalky changes in the vitreous substance, lymph close behind the lens, and particularly the so-called strumous deposit, are often found to be the cause of this appearance.

Whatever may be the substance which gives rise to the yellow reflection, both in cancer and in strumous deposit, we observe the bloodvessels. These vessels differ in size and arrangement from retinal bloodvessels, which latter, if the retina is displaced by fluid, accompany the movements of the floating fields of the displaced retina.

The diagnosis between strumous deposit and cancerous growth remains uncertain, as long as the former is on the increase. Both develop spontaneously, and may occur at any age. In this country, the strumous deposit is observed more often in fair than in dark-complexioned children.

The yellow substance behind the pupil, if covered by retina, appears smooth, but its surface assumes a flocculent, vascular aspect when the retina is destroyed. It may, if much pigment be present, have an almost black color, the gray or yellow and opaque portions only shining through in places.

While growing, it consists, microscopically, of elongated fusiform, or round nucleated cells, with intercellular substance traversed by bloodvessels. The cells rapidly increase in number, and are frequently mixed with pus-cells. When shrinking, an amorphous, smeary substance, with a few nuclei and cells, fat, cholesterine, pigment granules, and varying proportions of connective tissue, are found. As this deposit increases, it destroys the vitreous substance, and pushes the lens forwards. The iris becomes paralyzed, and the pupil extremely dilated.

In many cases the lens becomes opaque, and the iris and ciliary processes infiltrated.

Portions of sclerotic, adjoining the parts within the eye which are undergoing changes, may become vascular, swollen, bulging, and infiltrated. Suppuration of the cornea, or profuse purulent discharge from the interior of the eye, may take place.

The occurrence of pain seems chiefly to depend upon an increase of the tension of the eye. There may be no pain, if the "strumous deposit" increase slowly.

Strumous deposit may be spontaneously arrested at any stage. Such arrest most frequently takes place after the vitreous substance is destroyed. It establishes the difference of the disease from cancerous growth. The progress of strumous deposit is slower in grown persons than in children. It may appear in both eyes.

Its arrest most frequently shows itself by gradual shrinking of the eyeball, with increase of tension. The eye becomes flaccid, and finally reduced to a small irregular mass.

With the naked eye, no vessels containing blood could be seen in the tumor, which was easily broken away from its attachments. The fibres of the optic nerve disappeared in it. Its interior was softening. It consisted of cells of the size of pus-cells and larger, filled with granular matter; among these were pus-cells, and numerous capillary vessels, sprinkled with fat-globules and traces of connective tissue.

The outer and inner surfaces of the swollen and infiltrated choroid were thickly sprinkled with plexuses of capillaries, resembling blood-spots. Cells, similar to those in the tumor, were found in sundry infiltrated portions of the choroid and sclerotic, and in the little tumors along the sheath of the optic nerve.

Treatment.—The removal of the eye is indicated in those cases only in which the pain or suppuration threaten to exhaust the patient. General tonic treatment, and local frictions, with mercurial ointment, are adopted with benefit. In several cases of undoubted syphilitic character, arrest and decrease of the deposit have been effected by anti-syphilitic treatment. In some cases vision has been restored.

Pneumonia and meningitis are the usual causes of death.

BONY, FIBROUS, SARCOMATOUS, AND FATTY TUMORS.

Exostosis, of which the ivory exostosis is the most frequent, *enchondromato*, *fibro-calcareous tumors*, and *fibrous tumors*, with spicula of bone, have been met with. Bony tumors most frequently originate from the inner wall of the orbit, and thus may be mistaken for enlargement of the ethmoidal cells or frontal sinuses.

Fibrous and sarcomatous tumors spring from the periosteum of the orbit, by one or several pedicles. Fatty tumors are sometimes congenital.

Of the fibro-calcareous species, a specimen is in Dr. Walker's Eye Infirmary. It sprang from the inner and upper wall of the orbit, near the margin, and consisted of fibrous tissue, containing large irregular spaces filled with blood, and lacunæ, which were occupied by calcareous matter. It grew from the periosteum, inwards, *i.e.*, new material was deposited from the periosteum, and the latter displaced outwards.

CYSTS.

Cysts most frequently occur at some part of the inner wall of the orbit. They may become as large as hens' eggs.

Some are multilocular, with strong fibrous walls, and are barely attached to the orbit. They contain reddish serum, with cholesterine, or dark-brownish fluid (decomposed blood), or flakes of a grayish and opaque, cheesy-looking, substance (sebaceous cysts). The latter originate, as a rule, in the skin of the eyelids.

Hydatids (the cysticercus and echinococcus) and *hemorrhage* into the orbit are the most frequent causes of cysts in this region.

A *bursa* is occasionally found in front of, or behind, the insertion of the levator palpebræ muscle. This may become distended, and form a cyst, called a hygroma, which may give rise to protrusion of the eye.

Cysts may occur in the course of morbid changes of the lachrymal gland.

A case of *polypus*, commencing in the nose, perforating the orbit, and thence passing into the brain, has been observed. Death was caused by meningitis.

Treatment.—If, by an exploratory puncture, or by any symptoms, we have ascertained the existence of a cyst or cystic tumor, we should, as the shortest, and, in the end, least hazardous treatment, attempt its complete removal. In one case, in which a seton was introduced through the upper lid, and through the cyst, the eye resumed its normal position at the end of ten months. Ten years afterwards, the protrusion reappeared, and was arrested by another seton.

Excision of the front wall of the cyst has been followed by hemorrhage into its interior, and by increased protrusion of the eyeball. Rest, leeches, and cold fomentations have been required to check the protrusion.

In one case in which part of the wall of the cyst had been removed, a second portion had to be excised a year later. Delirium and much suppuration followed. Recovery took place three months after the second operation. Some advise the application of a paste, made with chloride of zinc, spread upon leather, to those parts of the cyst or morbid deposit not removed by the operation.

PULSATING TUMORS OF THE ORBIT.

The causes of pulsating tumors of the orbit usually met with have been—(1.) True or diffused aneurism of the ophthalmic, or some other artery within the orbit; (2.) Impediments to the return of the blood from the ophthalmic vein. Of these, the true aneurism of the ophthalmic artery is the least frequent.

The tumor, as a rule, appears during middle or advanced age; rarely spontaneously, or from bodily exertion, but frequently sooner or later after an injury. The pulsation, the protrusion of the eyeball, and other symptoms, in the larger number of cases, appear suddenly. The patient complains of a beating or throbbing in the eye, or over the eyebrow, which increases on stooping. The pulsation is communicated to the eyeball, and a loud blowing murmur, or a bruit synchronous, with the systole of the heart, is heard, by placing the ear upon the (upper) margin of the orbit.

In two cases of injury, all the symptoms of aneurism behind the eyeball were present, and yet none was found, in either case, after death. The symptoms were caused, in the one case, by partial compression of the internal carotid artery against the sphenoid, in consequence of swelling of the bone about the cavernous sinus. The cavernous, transverse, circular, and petrosal sinuses were inflamed and filled with pus.

In the other case, the ophthalmic vein, at its junction with the cavernous sinus, was found to be closed by fibrin and pus.

In these cases, the momentary increase of the quantity of blood in the orbit, during the pulsation of the ophthalmic artery, and the resistance offered by the walls of the orbit, together with the impeded return of blood through the veins, seem to explain the impulse imparted to the eyeball.

Treatment.—Ligature of the common carotid artery, of the side corresponding to the pulsating tumor, proved successful in eleven out of twenty-one cases in which it was performed. Two cases were cured by digital pressure upon the common carotid. This mode of treatment should be fairly tried, in every case, before proceeding to any operation. In several of the unsuccessful cases the pulsating tumors remained stationary. In one, the tumor returned after a few weeks; and in one, several small aneurisms appeared after the large one had ceased to pulsate.

NÆVUS "ERECTILE TUMOR."

Nævus has been observed at different depths in the orbit; most frequently in the neighborhood of the eyelids. In one case, the tumor was found, on dissection, to be enclosed in a "capsule" of connective tissue, which might have been removed by operation.

A nævus, when forming a tumor in the orbit, is soft to the touch, and increases in size and tension during crying or straining. It is rarely met with in grown people.

Varicose veins, situated near the margin of the orbit, and increasing in size on stooping, have sometimes assumed the appearance of tumors.

Treatment.—Several cases of nævus have been treated successfully by injection. Instances of sudden death after this operation have, however, occurred within the last three years. The pure tincture of perchloride of iron was used. The children died immediately after the injection.

Ligature of the nævus succeeded perfectly, in one case, and arrested the further increase of the nævus, in another case. The least dangerous, but slowest treatment, consists in drawing silk threads, saturated with tincture of perchloride of iron, through the nævus. Care should be taken that the threads are thick, and that they close the opening made by the needle. The number used must depend upon the size of the nævus. The object is to set up adhesive inflammation in different parts of the growth. The threads may be removed at the end of a week, or as soon as slight suppuration has set in around them. Other threads may have to be inserted, if the nævus has not disappeared, after all inflammation, caused by the first set, has ceased.

SPONTANEOUS HEMORRHAGE INTO THE ORBIT.

This form of hemorrhage generally comes on suddenly, *e.g.*, after illness, or after great fatigue in weakly persons, or after an injury, without any brain symptoms, with or without paralysis of all the muscles of the eye. It causes protrusion of the eye, without signs of aneurism. The protrusion remains stationary if the blood become encysted; if not, a fortnight or a month will suffice for recovery.

The general treatment must depend upon the patient's health. In persons with a tendency to hemorrhage, a recurrence of the protrusion may happen. Locally, several leeches, or a small blister to the temple, or frictions, with mild mercurial ointment, and gentle pressure upon the closed eyelids, with a bandage, may be tried.

Protrusion caused by hemorrhage behind the eye, during operations in or near the orbit, requires the immediate closure of the eyelids by a tightly-applied bandage, if necessary, with wire sutures, until the protrusion is subsiding.

EXOPHTHALMIC GOITRE.

PROTRUSION OF THE EYEBALL, WITH PALPITATION OF THE HEART, AND ENLARGEMENT OF THE THYROID GLAND (EXOPHTHALMIC GOITRE).

The nature of this form of protrusion, and the changes in the heart, arteries, thyroid gland, etc., with which it is associated, are not well understood. In some cases, the thyroid gland is not enlarged; in others, the heart appears healthy; in few, only one eye is found protruding. In most cases, no organic disease of the heart is found at the commencement of the protrusion.

As primary causes may be enumerated—atheromatous changes in the coats of the arteries, followed by hypertrophy of the heart; impediments to the return of blood, and subsequent enlargement of the thyroid gland: and as secondary causes of the protrusion —distention of the veins of the orbit, with an œdematous condition of the tissue within the orbit.

On *post mortem* examination of a case which occurred lately, neither hypertrophy of the orbital tissue, nor increase of fat, nor enlargement of the lachrymal gland, was found. The thyroid gland was enlarged, the left ventricle of the heart, hypertrophied, and atheromatous changes were observed in the arteries.

The youngest patient affected with this form of protrusion was ten years old. The patients, as a rule, suffer either from chlorosis, or frȯm morbid action of the heart, or from both. In females, the enlargement of the thyroid gland is more marked than in males.

The course of the disease is very chronic; it seems to be more acute in males. The first symptom generally observed is an abnormal action of the heart; the pulse is increȧsed in frequency from 80 to 150, and the impulse of the heart is strong, and accompanied by palpitations. A bruit is heard with the systole, in some cases. A sensation of tightness and of difficulty in breathing frequently follows. The enlargement of the thyroid gland, and the protrusion of one or more, generally of both eyes, occur later. The protrusion is preceded by insufficient relaxation of the levator palpebra muscle. The protrusion has been observed in about 16 per cent. of the cases. In 6 per cent. the sight of both eyes was lost.

The degree of protrusion varies. One or both eyes may be protruded straight forwards, and their movements equally impaired, in all directions. One eye, generally the right, may be more displaced than the other. The displacement may be so considerable as to give rise to difficulty in closing the lids, or to more or less complete exposure of the cornea. In the latter case, yellow, opaque, dry scales become accumulated upon the opaque and continually exposed portion.

Ophthalmitis may occur even while the corneæ are still protected The chemosis and varicose condition of the conjunctival bloodvessels vary in degree.

Treatment.—In weak or old persons the hope of recovery is slight. The greater the frequency of the pulse, the worse the prognosis. Rest, milk diet, the local application of ice, bathing the eyes with iced water, and such general treatment as the constitutional symptoms of the case may suggest, should be prescribed, if the pulse is above 100.

Preparations of iron are of great service, and may be continued for months or years, if the pulse is only from 80 to 100.

In one case, the administration of secale cornutum in ten-grain doses, four times daily, for two months, was attended by complete recovery.

Locally, frictions with iodine ointment, into the skin, over the thyroid gland, may be ordered, if the latter is enlarged. This treatment is expected to diminish the fulness of the orbit, and thereby the protrusion of the eye.

In cases of impaired mobility of the eyelids, the palpebral aperture has been narrowed by operation. By this means the cornea becomes more protected, increased pressure is exercised by the lids upon the eyeball, and the protrusion is rendered less conspicuous. The operation must be performed over both sides, and symmetrically, in order to enable the patient to close the lids readily.

If the surface of the cornea, from continued exposure, has become opaque, or covered with scales, the temporary complete closure of the lids is indicated, until, under general treatment, the protrusion has diminished, so as to admit of the lids readily protecting the cornea.

Much benefit is derived from the application of a bandage, causing slight pressure upon the closed lids during sleep.

PROTRUSION, THROUGH ENLARGEMENT OF THE FRONTAL SINUSES.

The upper and inner portions of each orbit, anteriorly, form part of the floor of the corresponding frontal sinuses. Large sinuses are generally accompanied by great prominence of the superciliary eminences. The sinuses are lined by mucous membrane, which is continuous with that of the nasal cavities. Their abnormal distention by mucus, etc., may be suspected, 1st, if we find the eyeball displaced outwards and slightly downwards, with a greater prominence of the anterior wall of the sinuses (*i.e.*, of the superciliary eminence); or, 2d, if we find a diffuse enlargement of the inner and upper portion of the orbit, anteriorly, compared with that of the healthy side; such enlargement may be accompanied by a more or less prominent swelling below the brow, of varying consistence (elastic or firm) and shape (smooth or uneven), with defined or undefined base. The skin may be unchanged and movable, or red and adherent to the swelling. There may be one or several fistulous openings. The swelling generally extends backwards, along the roof and inner wall of the orbit. There is hardly ever any pain.

Tumors attached to this part of the orbit, or circumscribed inflammation of the bone and periosteum, may be mistaken for enlargement of the sinuses. In periostitis, the great pain, especially at night, or when the part is touched, together with the relief afforded by medical treatment, may assist in the diagnosis of the case.

Most commonly, the sinuses are enlarged by accumulation of thick, transparent, or partly opaque, mucus, or by muco-pus, rarely by pus; this may be fetid and mixed with blood. The mucus or muco-pus is of the same kind as that which is secreted during catarrh by the mucous membrane of the nose. In rare instances, solid bony tumors, exostoses, and polypi, attached to the walls of the sinuses, or encroaching from adjoining cavities, have been found.

Injuries (blows on the face), causing obstruction of the passages between the sinuses and the nasal cavities, are the usual cause. Such has been found to be the case in eight out of nine instances. The enlargement may exist for a few weeks only, and then become perceptible, or it may continue for from four to six years without causing much inconvenience. The patient's attention is generally attracted when the enlargement displaces the eyeball, impedes its movements, and, as sometimes happens, causes diplopia, or some other derangement of vision.

Treatment.—Little benefit is derived from medical treatment. It should, however, be tried. In a case in which some insect had become lodged in one of the sinuses, and had caused irritation of the mucous membrane, the smoking of cigars, impregnated with arsenic, was found beneficial. A careful inquiry into the cause, the course, and the extent of the swelling and the inconvenience arising from it, determines the line of treatment.

Surgical interference is required, if the swelling increases rapidly, and impairment of vision becomes marked, or cerebral symptoms appear. If removal of the enlargement is decided upon, an incision is made below the supra-orbital ridge over the most prominent part, avoiding the supra-orbital vessels, etc. The incision must vary in length according to the size of the swelling; and should be at once carried through the soft parts down to the bone,—the blade of the knife being held parallel to the wall of the orbit, along which we wish to reach the swelling; we thus avoid wounding the eyeball. The most prominent part of the swelling, only, is exposed, and the point of the knife is thrust into it. If we find a solid tumor, we expose its entire surface freely, and remove it with the forceps, chisel, or gouge, either by breaking it off from its attachment, or by working round its base, and removing it as well as we can. The thinness of the walls of the orbit must be borne in mind.

If we find enlargement of the frontal sinuses by mucus, etc., an aperture, cut into the most prominent part, will enable us to expose and clear out the contents of the cavity with the finger or sponge, and to ascertain the relation of the enlarged sinus to the brain, to the eye, etc. In the cavity we may find rough portions of bone (from fracture or disease) or the expanded, smooth, mucous membrane only.

After having removed the mucus, one finger is introduced into the corresponding nasal cavity, up to the nearest part of the enlarged sinus; a bistoury is then passed through the opening made in the expanded bony walls of the sinuses to the spot corresponding to that touched by the finger introduced into the nose, and an incision is made through this part of the wall of the sinus down upon the finger, so as to establish a large opening of communication between the nose and the sinus. A "seton" (a strong cord of twisted silver wire, or a stout silk thread) is carried through this opening, and the end projecting from the nasal cavity is tied to the one which projects from the incision in the skin. The loop thus formed is moved by the patient, several times daily, with the view of establishing a permanent opening between the sinus and the nasal cavity. The patient has to keep in bed as long as there is headache, or much redness and swelling round the incision. The position of his head must be such as to facilitate the escape of matter. Cold-water dressing is applied over the wound.

The patient should be shown how to press upon the swelling over the "eye," so as to cause the discharge to escape readily through the external wound, and, if possible. also through the opening made into the nose, and how to move the seton to and fro, or to introduce some blunt instrument into the nose, and into the opening which leads from it into the sinus.

Four weeks after the operation, the seton may be removed. In some cases, it has been left in for several months.

This operation for removing enlargement of the frontal sinuses has succeeded in all cases. In one instance, the silver wire gave rise to much irritation and to cerebral symptoms; and was therefore withdrawn. However, the daily introduction (by the patient) of a smooth piece of ivory (the handle of a cataract-knife) through the nasal cavity into the opening, finally succeeded in restoring the normal dimensions of the sinus and its communication with the nose. In this case, the distention of (right) frontal sinus was very great, extending towards the brain, and as far back as the apex of the orbit. It caused displacement of the entire orbit, outwards and downwards, with protrusion of the eyeball. The eye ultimately resumed its natural position, and the orbit also nearly returned into its normal place.

In one case in which, from the commencement, there had been mucous discharge from the enlarged sinus into the nose, as well as a fistulous opening in the skin, the latter closed spontaneously in about two years.

Portions of the wall of the expanded sinus may become absorbed; or a communication may be established between the right and left sinus; or one or several fistulous openings, leading into the orbit, may exist.

This discharge of mucus, through the incision, or through a fistula in the skin, may continue; or the incision may close, and the distention reappear, and require reopening, if the above treatment have not been adopted.

After the operation, a deep cicatrix remains below the eyebrow, with light ptosis.

ACUTE INFLAMMATION WITHIN THE ORBIT.

Acute inflammation within the orbit often commences with more or less fever and pain in the head. If it increases rapidly, it is accompanied by much swelling and redness of the eyelids and conjunctiva. The conjunctiva is œdematous (serous chemosis), if the inflammation is slight, or deep-seated, or circumscribed; it is infiltrated with more solid matter (fibrin, pus), if the inflammation is severe, *e.g.*, if accompanied by suppuration of the eyeball. The swelling may be so great that the conjunctiva, protruding from the palpebral aperture, may become dry and covered with crusts; there is rarely much purulent discharge from its surface.

The eyeball, in every inflammation within the orbit, is displaced. Its movements are rendered painful and difficult, or are entirely prevented. A slight protrusion of the eye may appear considerable, from the great swelling of the lids. (See *Ophthalmitis.*)

At the commencement of the inflammation, the cornea often appears brilliant, the pupil contracted, the retinal veins large and tortuous, the retina œdematous, especially round the optic disk, which thus seems ill-defined, shading off into the adjoining fundus. The interior of the eye may, however, appear healthy; or morbid changes elsewhere may prevent us from obtaining a view of the retina, etc.

Vision may be slightly impaired or completely lost. The degree of impairment is frequently disproportionate to the visible intra-ocular changes. Flashes of light, fiery circles, etc., seen in the dark, are complained of in hyperæmia of the optic nerve.

The inflammation rarely remains confined to the tissues between the eyeball and the bony walls of the orbit.

The most frequent primary cause of this disease is some morbid changes in the bony walls; but whether they are actually implicated cannot be decided, so long as no access to the seat of inflammation, nor any opening for the escape of pus, exists.

Inflammation, if situated at the apex of the orbit, is dangerous, and its course is very protracted, however circumscribed it may be.

If, at the commencement, the inflammatory action is not too severe, or if it is soon arrested, no abscess may follow. A secondary attack, with protrusion, may occur after the first has subsided. Patients may die from meningitis or phlebitis, before an abscess has formed, or after perforation into the cranial cavity has taken place. This sometimes occurs suddenly after protracted suppuration, about the apex of the orbit. The more rapidly the inflammation increases, the greater is the danger to the eye, as well as to the life of the patient.

An acute inflammation generally has passed its height in from ten to fourteen days, while the morbid changes which may have occurred in the eye, in the bones of the orbit, or in other structures, may continue for years.

The inflammation is rarely chronic, unless it accompanies bone disease. Setting aside the changes in the functions and nutrition of the eye, we find that the inflammation either subsides gradually and disappears, or an abscess forms.

Besides the abscess, following inflammation of the bones of the orbit (*e.g.*, after injuries, fever, or erysipelas), we meet with rare instances of abscesses perforating the walls from without (*e.g.*, abscesses in the frontal sinuses, or in the anterior lobe of the brain) and breaking through into the orbit. In cases of abscess in which death has occurred, a sero-purulent infiltration of the tissues of the orbit, with pus in the ophthalmic veins and the cavernous sinuses, has been found.

There may be very little swelling and redness of the parts round the eyeball, previous to the appearance of pus. The abscess may perforate into cavities adjoining the orbit, or it may point beneath the conjunctiva, or somewhere on the surface of the lids, but rarely at more places than one. An abscess behind the suspensory ligament of the lids generally perforates the conjunctiva; but the pus escapes through the skin of the lid, when the abscess is formed in front of this ligament. After the escape of pus, the eyeball often recedes, and the redness and swelling of the lids, conjunctiva, and tissue within the orbit, disappear, if the cause of the abscess has been removed. In rare cases, though the lids and the eye return to their normal condition, an abundant discharge of pus continues for several months.

In a case of abscess within the cranium, in which the patient recovered, portions of brain came away occasionally with the pus. Other cases, in which the abscesses appeared simultaneously within the cranium, and in the orbit, proved fatal. In a case of glanders, purulent infiltration, and sloughing of the tissue between the eyeball and the walls of the orbit, occurred, together with one abscess in the choroid, and another in the brain. The abscesses were surrounded by yellowish-gray and opaque infiltration.

When pus escapes from an opening leading in the orbit, or from an incision made in the course of treatment, a careful examination must be made for *diseased bone.* A probe may have to be introduced into the orbit, at different times, before rough or necrosed bone can be discovered.

Caries of the orbit, if frequently superficial, but sometimes is seated far back at the apex. Pain is, as a rule, felt when pressure is made on the bone, near to diseased portions. If the latter be at or near the margin of the orbit, the diffused swelling of the bone, and periosteum, and the pain, are generally well marked. The granulations round the opening from which discharge escapes appear flabby and bluish-red, and the pus is dirty, yellow, and frequently offensive, as long as the morbid changes are progressing. The nature of the pus and of the granulations changes, as the caries or other disease subsides; the granulations become less numerous, and of better color; the pus becomes less abundant; and the sinuses and fistulous openings close. The openings may close before all the necrosed or carious portions are gone; in which case, fresh attacks of inflammation will ensue. A patient has been attending at Dr. Walker's Infirmary during the last seven years, on account of a minute fistulous opening, situated near the outer canthus. Whenever this closes, protrusion of the eye and ophthalmia appear, and continue, until, by pressure upon the temporal fossa, some pus is forced out through the opening. The portions of bone which, from time to time, come away, are generally very small.

The bone, during inflammation, loses its hardness; its earthy salts become absorbed; and the connective tissue predominates. Years may elapse before the disease comes to an end.

The cicatrices, following loss of bone, are deeper than those after any other form of inflammation of the orbit; and, according to their situation, impair the functions of the neighboring parts. If near the margin of the orbit, they may, through contraction, cause ectropion, with or without destruction of the surrounding skin of the lids by inflammation.

The lachrymal gland may be destroyed.

Treatment.—In every case of inflammation of the orbit we adopt some general treatment, *e.g.*, the anti-syphilitic treatment, if syphilis, or the suspicion of syphilis, exists; general antiphlogistic treatment (salines, bleeding from the arm, etc.), if injury is assigned as the cause.

If, from the history of the case, we infer the existence of a tumor, we treat according to the probable nature of the tumor. Cerebral disturbances and impairment or loss of vision are the chief complications to be avoided, whatever treatment we may adopt. Rest in bed must be enforced, in all cases, as long as the inflammation is acute.

We inform the patient of the danger to which the "sight" and the eyeball are exposed by the inflammation; and of the irreparable loss of "sight" which must ensue, if signs of suppuration in the vitreous are present.

A very protracted course must be expected, if we find diseased bone.

The degree of intensity of the inflammation, the changes in its products, and their relation to the functions of the eyeball, indicate variations in the line of treatment. Some believe the changes of inflammatory products into pus can be avoided by giving large doses of chlorate of potash; some recommend mercury, as having the power of altering the character of the inflammation; others adhere to simple tonic treatment.

If we suspect the presence of pus, whether the inflammation be acute or chronic, an incision should be made. We thus avoid fistulous openings, and obtain better cicatrices. The incision should be made early, and without waiting until the pus "points." It must be made large, if, on introducing the finger, we find the periosteum pushed away from the bone by pus. If the pain is very severe, or the cornea in danger (its surface dull, misty), the protrusion being caused by changes outside the eyeball, a narrow, long bistoury is thrust, at once, into the inflamed and swollen part, between the wall of the orbit and the eyeball, where the latter is pushed farthest away from the former; or the bistoury may have to be passed, in succession, close along the upper and lower walls of the orbit, if the eye is protruding straight forwards. A thorough acquaintance with the depth of the orbit and direction of its walls, and with the course of the optic nerve, must guide us as to the depth to which the bistoury can safely be introduced, and the direction it should take. The bleeding relieves the patient, even if no pus escape. The incision is kept open by passing a probe into it daily, or by introducing some lint, until the inflammation has somewhat subsided. After completing the incision, we should at once ascertain whether there is any diseased bone, and what is its situation and extent; bearing in mind, during the examination, the thinness of the upper wall of the orbit, and the neighborhood of the brain. The lids are kept closed by strapping, if the cornea is in danger.

Sometimes it becomes necessary to produce, temporarily, adhesion of the margins of the eyelids, in order to prevent ectropion, etc., arising from contraction of the tissue round fistulous openings.

If the inflammation of the skin and the pain are moderate, and the protrusion slight, we prescribe rest, frequent bathing, with lint dipped in cold or iced water (as long as the sensation of cold is pleasant to the patient), and an appropriate general medical treatment, always trying the iodide of potassium with sarsaparilla. If no increase of heat is felt, we apply gentle pressure, by keeping pieces of lint, dipped in warm water, or in warm poppy-head lotion, tied over the closed eyelids; we also order the unguent. hydrarg. nitrat. nitrus (a quantity the size of a pea) to be rubbed into the skin of the temple, morning and night.

If the inflammation is severe, especially if the fever is great, and brain symptoms are present, frequent application of lint, dipped in iced water, must be used, and changed as often as the lint becomes warm. In grown persons, the effect of from six to ten leeches, applied to the temple, may be tried, if no erysipelas exist.

If the tension of the eyeball is increased, or if hypopion, from purulent infiltration of the cornea, appears in the protruded eye, iridectomy, or repeated tapping of the anterior chamber, may be tried. Pus in the vitreous chamber, if there be much pain, must be let out by making an incision through the tunics of the eye, between the ocular insertions of the outer and inferior recti muscles.

If, after the incision has healed, and the inflammation subsided, the protrusion of the eye continues (*e.g.*, from thickening of the soft parts of the orbit), a bandage, causing slight pressure upon the closed eyelids, must be worn for some time.

In protrusion, from ophthalmitis, if there is much pain or prolonged sympathetic irritation of the fellow-eye, excision of the eye is the shortest and safest treatment; frequent fomentations, with warm water, or warm poppy-head lotion, will suffice, in the absence of sympathy or pain.

Necrosed bone generally comes away in small particles. It is extremely rare to find large pieces loose. Injections of warm water through the fistulous openings, to facilitate the escape of the portions of dead bone, reopening of fistulæ that may have healed, if an attack of inflammation within the orbit, with protrusion, occurs after their closure, and appropriate general treatment, are the measures that can be recommended. Years may pass before such cases are well.

Syphilitic nodes, if recent, are tender to the touch; sometimes they are accompanied by much periostitis. This occurs frequently along the margins of the orbit.

Periostitis accompanies most inflammation of the soft and bony parts of the orbit; its symptoms, if deep-seated. are those of inflammation of the soft parts within the orbit. It may assume an acute or a chronic character. It is readily recognized by the pain felt spontaneously, or when the inflamed portion is pressed upon. There is often also inflammation of the adjoining skin, if the periostitis occurs along or near the margin of the orbit. It may lead to suppuration, and abscesses, following it, have been mistaken for cancer.

Periostitis complicating disease of the antrum, and extending to the orbit.

In the cases observed, paralysis of the third nerve, with chemosis and protrusion of the eyeball, preceded the loss of vision, which occurred rather suddenly, *i.e.*, within a few hours from the commencement of the attack. No brain symptoms appeared. The periostitis probably caused rapid obstruction of the apertures leading into the orbit. Anæmia of the optic disk, with good blood-supply to the retina (showing the cause of amaurosis to be situated behind the spot at which the vessels pass into the optic nerve), were the alterations observed with the ophthalmoscope. From the permanent loss of vision and the subsequent atrophy of the optic disk, it may be inferred that the optic nerve-fibres were destroyed in their passage through the optic foramina.

The general treatment should be the same as is adopted in periostitis in other parts of the body. It must be carried on actively, on account of the dangers which threaten the eyeball and its appendages, as well as on account of the possible cerebral disturbances.

Inflammation of Tenon's Capsule.—This affection accompanies every acute ophthalmitis, and occasionally also occurs in cases in which a large portion of the sclerotic has been exposed during the operation for strabismus. Slight impairment of the mobility of the somewhat protruded eyeball, and swelling and redness of the subconjunctival tissue and sclerotic, are observed.

It resembles, if near the cornea, what is described as rheumatic ophthalmia.

Treatment.—Fomentations, with lint dipped in warm water, or in warm poppy-head lotion, with appropriate constitutional remedies, constitute the treatment, if the disease appears spontaneously. If it occurs after an injury, the antiphlogistic regimen, ice, cold applications, etc., come into use.

INJURIES.

If we suspect the orbit to have been injured, we must bear in mind that inflammation of the bones, impairment of vision, and other morbid changes caused by injury, may only become perceptible weeks or months after the accident has happened.

A foreign body may remain in the orbit for years, before giving rise to disturbance. A cicatrix, *e.g.*, in the upper lid, may guide us as to the spot at which it entered. If a recent wound exists, we should search at once for any foreign substance that may have passed into the orbit, and not wait for suppuration. We examine, if possible, the instrument with which the injury was inflicted, and inquire whether the patients suspect any portion to have remained in the wound. The throbbing in the orbit, displacement of the eyeball, pain round the orbit, indicate the probable presence of a foreign body. Otherwise, we treat as in cases of simple inflammation of the soft parts of the orbit.

A not unfrequent result of severe blows on the face is, closure of the communication between the nasal cavities and the frontal sinuses, and the gradual enlargement of the latter. Concussion of the bones of the skull has, in a few instances, been followed by inflammatory changes, which have given rise to slight protrusion of the eyeball, and to well-marked signs of aneurism within the orbit.

"Emphyseme of the orbit," with protrusion of the eyeball, from fractures of the inner wall of the orbit, readily subsides, if slight continued pressure is applied to the closed eyelids. Hemorrhage, beneath the conjunctiva, or into the orbit, has been observed after fractures of the upper wall of the orbit.

Amaurosis and amblyopia have been known to result from injury to the supra-orbital nerve, as well as from implication of this nerve in cicatrices, tumors, etc. Excision of a cicatrix, or of a portion of the nerve, where implicated, has been followed by recovery in some, by improvement in other, cases. With the ophthalmoscope, the optic disk has been found anæmic, in some instances, and in others, healthy in appearance, together with the rest of the eye.

THE EYELIDS.

ANATOMICAL AND GENERAL REMARKS.

The skin of the eyelids is thin and elastic, and the subcutaneous connective tissue loose, and free from fat. The skin is freely movable over the tarsal cartilages, and is thinnest where it becomes continuous with the conjunctiva. The loose and elastic tissue, which connects it with the orbicularis muscle, encloses hair-follicles, and numerous sudoriparous glands. This latter are small, and have tortuous ducts, each of which opens into the sheath of a hair, near its root. The looseness of the subcutaneous tissue explains the ready accumulation of blood or serum beneath the skin; as, for example, after the application of leeches to the lids.

The eyebrows (*supercilia*) are parallel with the upper margins of the orbits. They are very movable downwards and inwards (*e.g.*, when frowning), but hardly at all outwards and upwards. This peculiarity should be borne in mind when the surgeon is about to open an abscess or to remove a tumor; inasmuch as, if the incision be carried along the eyebrow, the resulting cicatrix will be hidden.

The eyelashes (*cilia*) project in two or three rows from the outer edge of the margin of each. They are farther apart at their points of emergence from the lids than at the extremities. They vary in length, color, and number. Those of the upper lid are thicker and larger. From 100 to 150 are in the upper, from 50 to 80 in the lower, lid. They grow during a certain time. After having reached their full size, they become thinner again, and at last fall out; the follicles becoming atrophied.

An eyelash is supposed to have arrived at the term of its existence in about five months; after which time its place is occupied by a new one. Every hair-follicle has numerous hair-bulbs; and the young hairs push out the full-grown ones. Frequently a young lash may be seen projecting by the side of an old one; in which case, the latter can readily be drawn out. After having nearly reached its full size, the lash grows very slowly. During the first month of its growth, it reaches a length of $\frac{1}{8}$ in., while, at the end of the fifth month, it has only increased to the length of somewhat less than $\frac{1}{2}$ in. altogether. The lashes of the lower lid grow less rapidly than those of the upper one. The hair-bulbs, with the follicles, are situated, some among, others beneath, the fibres of the orbicularis muscle; many are firmly adherent to the outer surface of the tarsus.

A horizontal incision through the lid, about $\frac{1}{8}$ in. from its outer edge, would pass through the largest number. Besides the proper eyelashes, there are numerous fine hairs, projecting from the skin, near them; these also have sebaceous glands.

The sebaceous glands of the lower lid are shorter than those of the upper ones; their ducts open into the sheath of the hair, just before it reaches the edge of the eyelid. From two to five $\frac{1}{78}$ of an inch in length, $\frac{1}{304}$ in. in breadth) go to each hair-follicle.

The cells, in these glands, resemble those of the sheaths of the eyelashes. They undergo a change into fat molecules.

The Meibomian glands are readily brought into view when either of the lids is everted. They appear as yellowish, nearly parallel lines, imbedded in the tarsus, shining through the conjunctiva, and passing towards the inner edge of the lid. About 40 glands are in the upper, about 30 in the lower, lid. Their ducts are straight. Their orifices open upon the rounded-off inner margin of the free border of the lid, previous to which, two or three sometimes unite into one. On transverse section, they are found to be surrounded by muscular fibres. In health, a greasy matter issues from the orifices. This consists chiefly of cells; the contents of which rapidly become changed into what resembles fat-globules, which escape from the cells, and constitute "the secretion of the glands." This "secretion" spreads over the moving surfaces of the eyelids and eyeball, and mixes with the secretion of the conjunctiva. Mixed with air, it gives rise to a white scum, at the outer and inner canthi.

The tarsus of each eyelid consists of dense, fibrous tissue, with only a few cartilaginous cells. It is covered externally by the orbicularis muscle and the skin, and internally by the conjunctiva. It gives the eyelid firmness, and maintains the shape of the palpebral aperture. But for the tarsus, the levator palpebræ muscle would, when contracting, cause this aperture to become triangular; and it would appear round during the action of the orbicularis muscle. The convex or attached margin of the tarsus merges into a fibrous structure, termed the suspensory ligament of the lid, which is inserted along the margin of the orbit. This is sufficiently strong to allow of the entire body being lifted from the ground by it. The tendon of the levator palpebræ muscle loses itself in it. Behind this fibrous structure we find the fat of the orbit.

The Muscles.—The levator palpebræ muscle raises the upper lid, the orbicularis muscle closes the lid. The latter is not a complete sphincter, but is interrupted ("inserted") at the inner palpebral ligament.

The different portions of the orbicularis do not contract simultaneously when closing the lids. The portion belonging to the lower lid is the stronger; it raises and slightly moves this lid inwards, towards the inner canthus, even when the upper lid is fixed. The orbicularis muscle extends beyond the margin of the orbit, where it is flat and thin. The portion which passes over and among the roots of the eyelashes is thicker than the remainder, and has been named the ciliary muscle (m. ciliaris).

The relation of its fibres to the surrounding parts is not well understood. The functions of the gland, the direction and growth of the eyelashes, and the position of the margins of the lids, may be affected by morbid changes of the muscle.

The Nerves.—The seventh (facial) nerve supplies the orbicularis muscle; the third nerve, the levator palpebra; and the fifth nerve furnishes the sensitive branches.

The Vessels.—The ophthalmic artery sends branches to the eyelids; the largest of which passes along the roots of the eyelashes, between the orbicularis muscle and the tarsus. The veins of the upper lid, like those of the eyeball, carry their blood into the ophthalmic vein.

The Outer and Inner Canthus, i.e., the Outer and Inner Angles of the Palpebral Aperture.—A fibrous structure passes from the temporal fascia, at the outer angle, and from the periosteum of the frontal and maxillary bones, at the inner angle of the orbit, over to the nearest portions of each tarsus. Before reaching the tarsi, this structure splits in two portions; one of which goes to the upper, the other to the lower, tarsus. The angle thus formed is termed the outer or the inner canthus, as the case may be; and the fibrous structure, the outer or the inner palpebral ligament. Into the lower margin of the inner palpebral ligament, numerous muscular fibres, coming from the outer anterior surface of the lachrymal sac, are inserted; it is likewise the point of insertion of some of the fibres of the orbicularis muscle; and, by some, it is described as the tendon of this muscle. It is readily made conspicuous by placing a finger on the skin, near the outer canthus, and drawing the latter outwards—a manipulation frequently resorted to during operations upon the lachrymal canaliculi.

The Margin of the Eyelids.—We distinguish an outer edge of the margin (the one from which the eyelids project), and an inner edge (which is rounded off, and rests against the eyeball), and a space between the two. The inner edges of the upper and lower lids do not touch each other when the lids are closed. This gives rise to a triangular space between the eyeball and the line along which the closed eyelids touch each other.

By momentary closure of the lids, *i.e.*, by the act of winking, particles of dust, epithelium, etc., are wiped away from the surface of the cornea; and the secretion of the conjunctiva and lachrymal gland are spread over it, and the tears directed towards the lachrymal passages. This act also exercises some influence upon the circulation of the blood in the choroid and retina. Eyes which become fatigued soon, wink more frequently than others.

DEVELOPMENT.

About the sixth week of fœtal life, we observe, as the first traces of the eyelids, two narrow folds of skin, projecting from the face, on either side of the nose. These gradually grow forwards and towards each other. About the end of the third month, they have the shape of the eyelids; but they are open, and apparently too small to close completely over the eyeballs.

At the beginning of the fourth month, the margins of the upper and lower lids touch each other, and become glued together; the palpebral aperture thus becoming temporarily closed. This closure persists during the fifth and sixth months. During this period, some clear fluid becomes accumulated between the eyelids and the eyeball.

Neither eyelashes nor eyebrows are perceptible before the closure of the palpebral aperture. These, the Meibomian glands and the tarsus, can be recognized about the end of the fourth month.

The hair-bulbs of the eyelashes appear a little sooner than the Meibomian glands. The separation of the margins of the lids occurs first at the orifices of the Meibomian glands; which temporarily give the free inner edges of the lids a somewhat serrated appearance.

CONGENITAL ANOMALIES.

Of the Eyebrows.—Anomalies as to quantity, color, and position. Two eyebrows, one above the other (in which case, repeated application of the tincture of iodine, and shaving off of one, has been found useful).

Of the Eyelashes.—Trichiasis, and distichiasis, and difference in color.

Of the Eyelids.—Absence of the eyelids, or congenital lagophthalmos; impaired growth, preventing the complete closure of the lids. Coloboma of the upper and lower lids of one eye (with harelip), and a too narrow palpebral aperture. (Symblepharon or anchyloblepharon), or union of the margins of the upper and lower lids with each other. Complete or incomplete ptosis, from paralysis, or from anomalies in the size of the lids, or from defective development of the levator muscle. A third eyelid, in the shape of a fold of skin, advancing from behind the inner canthus, over the eyeball. Pigment spots, nævia, fibrous tumors, with or without hair and warts.

Epicanthus is another congenital anomaly, consisting of a crescentic fold of skin, which overlaps, more or less, the inner canthus of each palpebral aperture. Personal gratification may require its removal. This is done by pinching up and removing a vertical fold of skin from the bridge of the nose, in a line with, and at an equal distance from, the inner canthi. The incision should be accurately united with sutures, and the epicanthus, if a sufficient quantity of skin has been removed, should have completely disappeared at the time of operation.

TUMORS.

Cysts in the skin are often observed, especially in elderly people. They appear as little, roundish, watery-looking tumors, single or in groups, along the outer edge of the lid. Some may be as large as hemp-seed.

The milium is a small, yellowish-white, and opaque tumor (nodule), of the consistence of cartilage, projecting among the eyelashes, from the margin of the tarsus. Several milia are generally present simultaneously. On minute examination, we find that the milium consists of concentric layers of cells.

Treatment.—Cysts and milia have been successfully removed, to improve the personal appearance, or on account of their irritating the cornea. So also have warts.

The molluscum glandiforme or albuminous tumor is whiter than the milium. Its surface is shining and slightly nodular. It projects from the skin, which is somewhat vascular, if the molluscum is large. It may reach the size of a large pea. When squeezed, milky fluid escapes through a small opening on the surface. It occurs frequently in children, accompanied by similar tumors in the skin of the lips, nose, etc.; and is supposed to be caused by some animalcule having become lodged in a sebaceous follicle.

Treatment.—With the cataract-knife, the tumor is divided into lateral halves, and then nipped well with a pair of forceps, or, better still, between the thumb-nails. The halves of the whitish, nodular, solid substance are thus squeezed out. The empty bag of loose skin is left. The tumor "returns," if it has not been squeezed out thoroughly. All such tumors about the face or lids should be removed at one sitting.

The molluscum can always be removed in this manner; not so the milium.

The tarsal tumor (encysted tarsal tumor, cyst in the tarsus, chalazion). One or several such tumors may occur in the same eyelid. They are the result of morbid changes of the glands within the tarsus, and are often preceded by inflammation (styes).

The tumor is usually situated near the inner surface of the tarsus. Sometimes it perforates the conjunctiva, and a few granulations surround the opening. When the tumor projects from the outer surface of the tarsus, its position can be readily recognized by everting the eyelid. A darkish, gray-red spot, covered with abnormally vascular conjunctiva, indicates its situation.

Treatment.—Derangement of the functions of the eyelid, or of the cornea, or other reasons, may require the removal of the tumor by operation. If several tumors are present, all should be removed at the same time.

The patient, seated in a chair, rests his head against the chest of the operator, who stands behind. The hands and eyelids of the patient must be secured.

The tumor is removed through the conjunctiva. The eyelid is everted, and, with a narrow-pointed knife, an incision is made through the abnormally vascular conjunctiva, and the gray-red, thinned portion of the tarsus. The knife may have to pass through the entire thickness of the tarsus, if the cyst is near the outer surface. The texture of the tarsus being very dense, some force has often to be used to carry the instrument through it into the tumor.

The incision, made parallel with the margin of the lid, should be equal in length to the greatest diameter of the tumor, as felt through the skin. A cross incision is sometimes necessary, if the tumor is large. Generally some serum, pus, or gray, gelatinous substance escapes at once. A small scoop is then carried along the surface of the tumor, with a view to separate the bulk of it from the surrounding tarsus. If this does not succeed, the scoop should be turned rapidly about, to break away the gelatinous contents from the walls of the cavity. This must be continued until all seems to have escaped. Blood frequently fills the cavity, and the tumor often appears even larger than before the operation. If all the contents have not been removed, we may, at some future time, be compelled to use the scoop a second, or even a third, time. This does not occur, if the operation is performed thoroughly at first. Cold-water dressing is applied to the lids, for a few days.

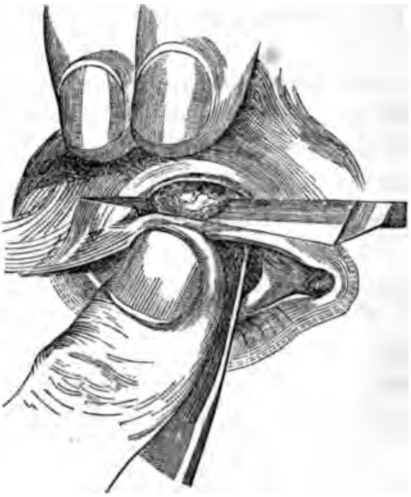
If, after ten weeks, the tumor or the hardness has not completely disappeared, a second operation may be required.

The Sebaceous Tumor.—This tumor is generally observed in children. It is congenital, and almost always situated beneath the skin, near the outer and upper margin of the orbit. It sometimes reaches the size of a small walnut, and, if large, is, in part, adherent to the skin. The skin usually maintains its natural color; sometimes it is vascular, where the tumor is adherent; in rare cases, a small opening leads into the tumor, which, on pressure, gives vent to some sebaceous matter, of an unpleasant smell. The matter is enclosed within a capsule of varying thickness, together with hairs, of the shape, and often of the color, of those of the eyebrows. These may be found attached to the sac, or curled up and mixed with the sebaceous matter.

Old tumors of this kind consist of yellow, oily substance, enclosed in sacs of fibrous tissue, which are often extremely thin.

The tumor is the less movable the more extensive its adhesion to the periosteum of the orbit.

Treatment.—The tumor, if thoroughly removed by operation, does not return. It rarely suffices to puncture it, and cauterize the interior. Chloroform should be administered, the operation being a tedious one, and accompanied with troublesome bleeding. Two assistants are required. While one assistant holds the head of the patient, and another is ready with a sponge to restrain the abundant hemorrhage, a small horn-spatula, or the index-finger of the operator is pushed under the lid, which is tightly stretched by the aid of the thumb, and made to project as far as possible. Then an incision is made parallel with the edge of the lid, on the summit of the tumor, throughout its entire length. This incision should pass beyond the base of the tumor, at both extremities. The surface of the tumor is then exposed by dissecting up the integument and the muscle, and a cataract-knife is entered at the base, and passed through its whole length. The tumor is thus almost separated from the cartilage. It is then seized with the forceps and completely removed by the scissors. A good view of the tumor must be maintained by keeping open the large skin incision, and sponging away the blood. After having separated the adhesions of the tumor, to the skin and other soft parts, we cut through its attachment to the periosteum, which may be broad or have the form of a pedicle. The white sebaceous matter escapes, if the tumor has been opened during the operation: this renders the complete removal difficult. Portions of the walls, left behind, should be touched with nitrate of silver.



(Fig. 37.)

Incisions through the suspensory ligament and removal of portions of the fat of the orbit may readily be avoided by dissecting close to the walls of the tumor.

The wound being deep and lacerated, some suppuration generally follows; lint, dipped into cold water, is applied, as frequently as is pleasant to the patient. We may, to hasten union, insert one or two sutures, near the corners of the incision. The wound heals in from two to three weeks; the cicatrix is scarcely perceptible, and no other disfigurement follows.

Nævus, about the eyelids, occurs frequently. One or several may be found in the same eyelid; or may extend from the eyelid into the orbit. The appearance and symptoms are similar to those elsewhere. If not operated upon, the nævus increases to a certain size, and then remains stationary, or becomes smaller.

Treatment.—Ligature and injection of the tincture of perchloride of iron have been followed by sloughing of the eyelid. The safest and quickest method is to completely remove the nævus by operation, if its size and situation permit. The parts may be rendered insensible by the ether spray.

Another effectual method of treatment consists in the destruction of the nævus, by means of the galvanic current.

Next to this can be recommended the insertion of stout silk threads, previously moistened with tincture of perchloride of iron. Due regard must be paid to the portion of the eyelid we operate upon, in order to avoid disfigurement, displacement, etc.

Lupus has been observed in various stages in the eyelids, either extending from the face, or commencing in the lids (generally along their margins). By extension to the eye, or to the orbit, it has caused death, in several instances.

It generally appears in young people of otherwise good health; it spreads over large surfaces (different stages of the lupus being present simultaneously); it leaves peculiar star-shaped cicatrices; it is painless; and it is curable. In these respects it differs from epithelial cancer. Syphilitic ulcers are, as a rule, primary, and commence with thickening along the margins of the lids.

Syphilitic infiltrations, from the slowness of their course, their hardness, and, if ulcerating, from the dirty appearance of the ulcer, can hardly be mistaken for acne.

The local application of mercury is found of great use.

Cancer of the Eyelids.—The medullary and melanotic forms are rarely primary. Nodules of both forms, springing from the margins of the lids, have been removed by excision.

Both forms frequently extend on to the lids, from the eyeball or orbit.

Epithelial cancer appears under the form of small, roundish, hard nodules, or so-called alveolar cancer.

The nodules, situated in the skin of the lid, or over the lachrymal sac, at a later period, become covered with yellow crusts, and overrun by enlarged veins. Beneath the crusts, we find ulcerating surfaces, with irregular outlines and everted margins, secreting but little pus, etc.

The alveolar cancer appears either as a defined tumor, or as an ill-defined infiltration. The latter form is less common; and occupies the skin, or commences beneath it, and is painful when touched. The dark-red, nearly flat surface of the cancerous infiltration, after some weeks, becomes ulcerated. Crusts appear, with an offensive purulent discharge. The edges of the ulcer are swollen, roundish, and nodular.

Epithelial cancer has been mistaken for lupus. It may exist for years. In the alveolar form, the neighboring glands are much sooner affected. Cases have occurred in which the eyeball has been destroyed by numerous attacks of inflammation.

Treatment.—The cancer, if small, confined to the skin, and occurring in a strong patient, may be removed by operation. The loss of substance is covered by skin, transplanted from healthy neighboring parts.

The cancer reappears more speedily, if the operation be performed after the glands have become implicated.

The cancer may be also successfully treated by the application of a paste made of starch and chloride of zinc.

The paste must be freshly made for each application.

The paste is spread over the surface and margins of the ulcer, and over a narrow strip of the adjoining healthy skin. The layer of paste should be sufficiently thick to hide these parts from view; and care should be taken not to touch the eyeball. The paste temporarily destroys the growth; and a cicatrix forms. The application is repeated whenever any part of the margin of the ulcer shows an inclination to extend itself, or when fresh nodes appear. The general health of the patient should be well supported.

Palpebral ephidrosis is the term applied to an unusually large secretion of perspiration by the skin of the eyelids. In the cases observed, it has been confined to the upper lids. On wiping away the confluent drops, others soon appear. Slight ophthalmia and eczema are the consequences.

Phthiriasis signifies the presence of crab-lice among the eyebrows and eyelashes.

The pear-shaped egg of the crab-louse (phthirius) is attached to the hair, close to the skin, by means of a transparent cement. A lid, found at the broad end of the shell of the egg, falls off, on completion of the intra-oval life of the insect. The lice and their eggs, when present in large numbers, give rise to an appearance as if the eyelashes were covered with yellowish, gray, and brown crusts, as observed in tinea. These crusts, on close inspection, present a marked leaded form, and, when pressed between the nails, burst suddenly.

Treatment.—The daily application of the unguent. hydrargyri nitratis mitius, or of a solution of the hydrarg. bichloridi (gr. j. ad aquæ ℥j.), by means of a camel's-hair brush, to the "crusts," on the eyebrows and eyelashes, suffices to destroy the lice, within a few days.

PARALYSIS OF THE ORBICULARIS MUSCLE (SEVENTH NERVE).

The paralyzed eyelids are wide open, and cannot be closed at will; and the margin of the lower lid sinks away from the eyeball.

A thorough, voluntary relaxation of the levator palpebræ muscle, however, nearly suffices to "close" the upper lid. The lid remains immovable, if the levator is likewise paralyzed.

In rare cases, though the power of moving the lids voluntarily may be lost, reflex movements (during sneezing, exposure of the eye to strong light, etc.) may still occur. The continued exposure of the eyeballs gives rise to epiphora, irritation, inflammation of the cornea, etc.

PARESIS OF THE ORBICULARIS MUSCLE.

The more prominent symptom of paresis is epiphora, accompanying inability to close the lids forcibly, or to throw the skin of the lids into folds.

The causes of paresis and paralysis are:—inter-cranial changes (*e.g.*, congestion of the brain, apoplexy, etc.), which generally affect both orbicularis muscles; morbid changes of the structure of the orbicularis muscle itself, or of the parotid, or of the seventh (facial) nerve. The paralysis may be confined to those branches of the nerve which go to the orbicularis muscle.

The treatment belongs essentially to the domains of general medicine and surgery.

The irritation caused by the epiphora, and by exposure of the eyeball to the air, etc., is best overcome by keeping the eyelids continually closed.

Neuralgia in the frontal branches of the fifth nerve ("pain over the eyebrows," "in the forehead") appears, in rare cases, independently of the eye. In such cases, especially if periodical, three to five grain doses of quinine will be found of use. Still better are subcutaneous injections of a solution of the acetate of morphia.

Similar injections, beneath the skin of the temple, are of temporary use, also, in those forms of inflammation of the eye which are accompanied by severe pain. The effect is produced in a quarter or half a minute after injection. A quantity, of from $\frac{1}{10}$ to $\frac{1}{2}$ of a grain, generally $\frac{1}{5}$ or $\frac{1}{6}$ of a grain, of the acetate of morphia, in solution, is injected at one time.

In irritable people, even small doses cause sickness or vomiting, with shortness and quickness of breath.

We should not neglect, in cases of neuralgia, to examine the refraction of the eye, particularly if pain is felt during reading.

Properly selected spectacles have often removed long-continued neuralgia.

SPASM OF THE MUSCLES OF THE EYELIDS.

SPASMODIC CONTRACTION OF THE LEVATOR PALPEBRÆ MUSCLE.

This form of spasm occurs very rarely. The eyelids, during the spasm, are wide open. The upper lid resists attempts to close it with the finger. This affection has been observed during morbid changes of the urinary organs, and after injuries.

SPASM OF THE ORBICULARIS MUSCLE (BLEPHAROSPASMUS)—SPASMODIC CLOSURE OF THE EYELIDS.

Blepharospasm is frequently observed. Morbid changes in the seventh (facial) nerve, or cerebral changes, may give rise to it. Sometimes it appears combined with neurosis of the facial nerve and spasm of the ciliary muscle. Most frequently it is the result of morbid changes of the surface of the cornea acting upon the sensitive nerves (first division of the fifth), and of these, in their turn, reacting upon the seventh.

The spasm may continue after the primary cause (irritation of the fifth nerve) has subsided; or it may have given rise to entropion, which, in itself, keeps up the irritable condition of the cornea and the spasm.

Treatment.—The spasmodic closure of the red, swollen, and tense lids, occasionally occurring in the course of purulent ophthalmia, subsides, on the cessation of the ophthalmia, unless kept up by morbid changes in the cornea.

The spasm, when accompanying inflammation of the tunics of the eye (especially syphilitic and pustular corneitis, ulcers, abscesses, and abrasion of the cornea), sometimes continues after all inflammatory changes have passed; and is attributed to undue irritability of the orbicularis muscle itself.

The spasm readily subsides after the insertion of a seton into the skin of the corresponding temple, or after division of the supra-orbital nerve; by which means, the muscle is rendered temporarily insensible.

The forms of spasm, in which the eye appears otherwise healthy, are often accompanied by neuralgia. In such cases, spasmodic contraction (*e.g.*, of the face) may lead to spasm of the orbicularis; and, *vice versa*, spasm, commencing in the orbicularis, may spread to other muscles. In one case, epileptic fits were finally induced, which ceased after division of the supra-orbital nerve.

In such cases, we must ascertain whether the spasm is arrested by digital pressure upon the sensitive, or upon the motor, nerves of the orbicularis, or upon both kinds of nerves, or upon their branches.

The nerves which deserve our special attention are: the supra-orbital, the infra-orbital, the subcutaneous malæ. the lower maxillary, and the auriculo-temporal.

Sometimes we find diseased bone or periostitis to be the cause; and, by medical treatment, succeed in removing the spasm. Generally, however, we are compelled "to perform neurotomy," *i.e.*, to divide the nerve branches, and the arteries next to them; which, when pressed upon, cause the spasm to cease.

For these operations, chloroform should be given. The instrument for dividing the nerve and artery is thrust through the soft parts down to the periosteum, close to the spot where we propose dividing the nerve. It is then carried along the periosteum, to, and a little beyond, the nerve; and the latter, together with the artery and periosteum, are cut through. Pressure, by means of a pad of lint, is applied, to arrest hemorrhage.

Hyperæsthesia of the retina occasionally gives rise to spasm, or to frequent winking. The hyperæsthesia may be accompanied by an unusual sensibility of the cornea and conjunctiva.

Attention must be paid, in these cases, to the tension and refraction of the eye (anomalies of which are a common cause of hyperæsthesia).

Trembling or spontaneous twitching ("the live-blood"), especially of the lower lid, which may increase to spasmodic closure of the lids, is observed in many hypermetropic persons. It is probably a symptom of undue contraction of the ciliary muscle. It often ceases after the instillation of atropia, or after treatment of the hypermetropia.

A blister in front of the ear (over the seventh nerve), or the endermic application of atropia (gradually increased from $\frac{1}{12}$ to $\frac{1}{4}$ of a grain of atropia), has also been found of use.

The spasmodically closed lids exercise continued pressure upon the eyeballs, and may thus cause protracted impairment of sight. This complication, or changes in the cornea, may require the speedy removal of the spasm, by division of the supra-orbital nerve.

For the treatment of entropion, with spasm of the orbicularis muscle, see *Entropion.*

INFLAMMATION OF THE EYELID.

The term *anchylops* is applied, by some, to circumscribed inflammation about the eyelid, at the inner canthus; and the term *ægilaps*, to perforation of an abscess at the inner canthus. Inflammation of one or several of the glands of the eyelashes is described under *Acne Ciliaris;* inflammation of the bulb and follicles of the eyelashes, under *Tinea;* and acute inflammation of the Meibomian glands, under *Stye.*

The causes of inflammation, commencing in the eyelids, are: injuries (burns, blows, stings from insects, etc.), severe illness (scarlatina, measles, pyæmia, etc.). More frequently, however, the inflammation follows or accompanies severe inflammation of adjoining parts, as purulent ophthalmia, ophthalmitis, erysipelas, inflammation of the gland adjoining the eyelids, etc.

The swelling of the "inflamed" lid or lids is generally considerable, and often prevents their being opened. It is caused by the rapid increase of nuclei and cells, of the various structures of the lid, and by these structures becoming infiltrated with serum and blood.

No case is recorded in which abscess has followed inflammation, accompanying purulent ophthalmia or ophthalmitis. Abscess "by metastasis" often forms, if the inflammation appears after severe illness. The skin becomes dense and painful to the touch, until pus has escaped.

The pus occasionally perforates the conjunctiva, or it undermines the skin, and escapes through several openings. Abscess occurs more frequently about the eyebrows, the upper lid, and near the inner canthus. In the latter place, it may be mistaken for abscess of the lachrymal sac.

The inflammation generally passes off without permanently disturbing the appearance and functions of the lid. If occurring repeatedly in the same lid, it gives rise to hypertrophy.

Disturbances of the functions of the lachrymal passages, cicatrices, irritating the cornea or disfiguring the lid. Ectropion, entropion, or symblepharon, may follow the inflammation. Slouching of part, or of the whole, of one or both of the eyelids, has been observed in inflammation, following erysipelas, and after severe illness.

Treatment.—At the commencement of the inflammation, when caused by injury, we order the frequent application of pieces of lint, dipped in cold or iced water, to be continued as long as the sensation of cold is pleasant. Applications of lint, dipped into cold water, should be tried, also, in inflammation from other causes; but must be discontinued if the cold is unpleasant, and a simple poultice, during sleep, and the frequent use of lint, dipped into warm water, or into warm lotio papaveris, may be substituted.

If an abscess is found, an incision is made, at once, parallel with the margin of the inflamed lid, and sufficiently large to allow of free escape of pus. Sometimes a small, spontaneous opening has to be enlarged, or several openings have to be united into one, or a counter-opening may have to be made into the skin, after spontaneous perforation of the abscess, through the conjunctiva.

The lids, after the pus has escaped, are kept closed by the application of lint, dipped into warm water, and by a bandage, which should exercise gentle pressure. The lint has to be changed frequently. Bathing the eyelids with lotio aluminis, for five minutes, several times during the day, will be found of use, if there is purulent or mucous discharge from the conjunctiva.

The state of the eyeball may require examination; in which case, the swelling sometimes necessitates the use of the wire-speculum. This operation is painful, and requires the administration of chloroform.

In inflammation of the eyelids, as a complication of changes of the eyeball, we must inform the patient, or parents, of the

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PTOSIS.

Ptosis, or drooping of the upper eyelid, with inability of voluntarily raising it, may be caused by paralysis or paresis of the branch of the third nerve which supplies the levator palpebræ muscle, before it reaches that muscle, or by alterations of nutrition of the muscle itself, or of the entire eyelid.

In the first case, it is generally complicated with paralysis of the ciliary muscle, of the sphincter of the pupil, and of one or several of the recti muscles.

On raising the drooping lid, we find divergent strabismus, and the pupil somewhat enlarged and fixed. In complete ptosis, the upper lid hangs motionless, and the outer canthus appears lower than that of the fellow-eye.

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(3.) Of increase of weight of the lids, in aged persons, from superabundance of skin, with weakness of the levator palpebræ muscle.

In all cases, the action of the levator palpebræ muscle is often further impeded by narrowing of the palpebral aperture.

After all inflammation has ceased (1), and the intolerance of light has subsided (2), we can, by the removal of some skin, and the orbicularis muscle, along the margin of the anterior surface of the tarsus, improve the condition of the patient; who, for personal reasons, or to improve the sight, may be desirous to undergo the operation.

To determine how much of the skin to remove, we pinch up a fold, along and parallel with the margin of the lid, so as to raise that margin above the upper edge of the pupil, while the eye is directed straight forwards. When the fold of skin is raised, the patient must be able to close the lids readily, without effort. The fold is removed with scissors. Then, a strip of the orbicularis muscle, varying in width from one-fifth to one-quarter of an inch, is dissected away from the tarsus; particular care being taken to remove the thick portion attached to the edge of the tarsus. One suture is applied midway between the outer and inner canthus, and is carried through the outer edge of the margin of the eyelid (tarsus), and through the nearest portion of skin. The wound heals within a few days. Cold-water dressing may be applied. The suture often comes away spontaneously.

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Ptosis from paralysis of the third nerve, the result of tumors, of syphilitic or rheumatic changes, or of abscesses in other parts, or occurring during congestion or hemorrhage into the brain, as a rule, appears rapidly. The treatment must be directed against the morbid changes which may have caused the paralysis.

Some patients have derived benefit from raising the eyelid during the day by means of a metal suture, or strapping.

The operation of raising the lid by removal of some of its skin and muscular structure is not advisable.

An operation, the object of which is to raise the orbicularis muscle and tarsus beneath the skin of the eyelid, and thus to diminish the width of the drooping lid by a cicatrix formed between the displaced portions of the orbicularis muscle and tarsus and the skin, has in a few cases proved successful. An incision is first made parallel with, and about an eighth of an inch from, the outer edge of the margin of the eyelid, through the skin down upon the orbicularis muscle. The skin is then dissected away from the orbicularis to the extent of the tarsus, and a little beyond its upper margin. A loop of silk is next passed round some of the bundles of the orbicularis muscle, near the margin of the eyelid, at an equal distance from the outer and inner canthus. The silk is carried upwards, beneath the skin and out at the eyebrow, and fixed there. One or two more silk threads may be inserted in the same way along the margin of the lid. The effect is to raise the tarsus and orbicularis muscle behind the skin, which is thrown into fold and overlaps the margin of the lid.

Cold-water dressing is applied frequently, and the patient should be kept in bed about a week. The swelling, etc., of the lid has been considerable in several cases. The silk threads are removed about the eighth day, by which time the displaced muscle and tarsus are supposed to have become adherent to the skin.

THE STYE.

The stye is a small, red, roundish, smooth, hard, and elastic swelling, situated "in the eyelid," with the skin movable over it, and with the swollen red margin of the lid rounded off, if the stye is near it. It is caused by morbid changes of one or several of the Meibomian glands, accompanied by more or less acute inflammation. On everting the eyelid, a grayish or yellowish ill-defined spot, surrounded by vascular, and sometimes granular, or swollen conjunctiva, may be seen. This indicates the portion of the stye which lies nearest the conjunctiva. Small styes may escape notice. Several may appear simultaneously. They are the more conspicuous the more the skin and tarsus are implicated in the inflammation. The swelling of the lid or lids may be so considerable as to prevent their being opened.

The lid, at the commencement, "itches," or feels "stiff"; it then becomes painful. Some patients at first complain of headache, and feverishness. In a few days the matter points; at last some pus escapes, generally near the margin of the lid, through the conjunctiva, or through the skin, together with a peculiar grayish, gelatinous-looking substance, consisting of ill-developed connective tissue. In rare instances, the pus escapes into one of the lachrymal canaliculi. The lid, after this, either soon resumes its natural appearance, or "a granulation," or some gray and opaque substance, may be seen for a considerable time projecting from the opening of the perforation, especially if situated in the conjunctiva. In some cases no perforation is observed. In others, the stye, sometimes without preceding acute inflammation, after escape of pus, takes on a chronic course, and appears as a little hard tumor in the substance of the tarsus. It is then termed a chalazion.

In chalazion we generally find ill-developed connective tissue, mixed with a fatty or chalky-looking substance. If the chalazion, however, is old, a brownish turbid, or a clear oily, fluid is found. The skin and conjunctiva over it are unduly vascular.

Styes occur in persons of delicate health, and in those troubled with acne; and sometimes after or during the different forms of purulent ophthalmia. They frequently reappear periodically in the same eyelid during several years.

Treatment.—At the outset of the acute inflammation, we order the lid to be washed frequently during the day with lotio papaveris mixed with hot water in equal proportions, and a hot linseed-meal poultice to be applied over the closed eyelids during sleep.

A small incision parallel with the margin of the eyelid, through the part where the pus points, hastens the course, and relieves the patient sooner, but it need not be insisted upon if an operation should be objected to. Appropriate general medical treatment, and bathing the inflamed lid with lotio papaveris, suffice after the escape of pus. All redness and swelling should have disappeared in from two to four weeks after the commencement, unless a chalazion follows, which for its removal requires an operation.

Acne Ciliaris.—Acne ciliaris signifies inflammation of one or several of the glands of the eyelashes. The gland or glands become expanded, their secretion is morbidly altered, the nutrition is disturbed, and the surrounding tissue becomes inflamed. This affection varies in degree, and occurs more frequently in the upper than in the lower lid, probably on account of the glands being larger and more numerous in the former than in the latter. Externally, if the inflammation is severe, we find the entire lid red and œdematous, and the skin over the swelling tense and painful. If the inflammation becomes developed rapidly, suppuration of the contents of the gland may follow, with perforation of the skin at or near the edge of the lid. The patient may be feverish at the commencement of the inflammation.

If the inflammation is slight, we find a circumscribed roundish, defined red swelling at or near the outer edge of the lid, with a few dry, yellow, and opaque crusts adhering to it and to the eyelashes. The margins of the lids sometimes undergo changes similar to those observed after tinea.

Acne, though observed at any age, and usually in the spring of the year, appears most frequently about puberty, and in persons who have acne nodes in other parts. The course is generally chronic, in consequence of the glands being affected in succession.

Treatment.—A small vertical incision is made into the inflamed skin, if the pain is great, to let out blood or pus. A linseed-meal poultice is placed upon the closed lids during sleep, until all redness has disappeared. In other respects we adopt the local treatment of tinea.

Pustular ophthalmia and corneitis, which often exist simultaneously with acne, require separate treatment. We also adopt the general medical treatment which is usual for the removal of acne in the skin.

TINEA.

(*Tinea Ciliaris; Blepharitis Ciliaris, or Marginalis; Tinea Palpebralis; Follicular Blepharitis; Psorophthalmia.*)

Patients suffering from tinea generally present themselves with yellow, dry, and opaque crusts adhering to the eyelashes. Parts or the whole of one or both eyelids, also, are slightly red and swollen along the margin.

The crusts consist, chiefly, of dried pus. We find, after their removal, the surface of the margin of the lid raw or fissured, easily bleeding, and scattered over with small ulcerations (the result of pustules). The entire margin may be thus changed into an ulcerating surface. Its inner edge sometimes appears uneven, from granulations springing up, during the course of time. Considerable swelling of the lid, with pain and intolerance of light, may occur in the commencement of the inflammation, especially if complicated with pustular, catarrhal, or granular ophthalmia, as is often the case.

The course of the disease is chronic, and may be protracted through life. It frequently recurs at certain periods of the year, *e.g.*, every spring.

When the disease is at an end, the crusts fall off, and the corresponding margin of the lid appears thickened (so-called tylosis, or pachy-blepharosis).

The tissue surrounding the roots of the hair-follicles becomes hypertrophied, and the nutrition of the eyelashes impaired, unless tinea is properly treated.

The margins of the lids appear rounded off, and the skin and conjunctiva, in extreme cases, are blended into one smooth, red, shining cicatrix, without eyelashes or Meibomian gland orifices. A few badly-nourished pale eyelashes may be seen, which, by thickening of the margin of the lid, or by cicatrices following the ulcerations, are displaced, inverted, etc. The conjunctiva is more or less everted. Ectropion, through destruction of skin and contraction of cicatrices, may follow.

This extreme stage of tinea is termed *lippitudo.* Displacement or closure of the lachrymal puncta and canaliculi, with epiphora, continuous winking, and irritability of the eye, are frequent sequelæ.

Among *constitutional causes* must be mentioned variola, measles, scarlatina, and, especially, syphilis; among *local causes,* the different forms of purulent ophthalmia.

Tinea occurs most frequently in children and in young persons.

Treatment.—An anti-syphilitic or a tonic treatment is adapted, according to the general aspect of the patient. Much benefit is derived from the "liquor Fowleri," especially if the upper lid and alæ nasi are swollen at the same time. To adults, we give gutt. x. of the liquor, with mist. ferri co., to be taken twice daily. For a child six weeks old, we order vini ferri ℥iij., liquor Fowleri gutt. iij.; one teaspoonful to be taken twice daily.

Exercise in the open air, and general cleanliness, must be enforced.

Locally, we have to prevent the accumulation of crusts. These are most easily removed by patiently touching them with a sponge dipped in warm water, or, better still, by using the eye-douche with warm water, until they are softened, and can be wiped off. The inflamed margin of the lid is then dried, and the places from which the crusts have been removed are painted over with a camel's-hair brush dipped in lotio plumbi acetatis. This is repeated three times daily. At bedtime, after using the lotion, some unguentum hydrargyri nitratis mitius, made with glycerine, is applied with the camel's-hair brush, or with the finger, along the inflamed margin of the lid.

If, after the removal of the crusts, we find many ulcerations or fissures, we either make puncture into the skin, along the edge of the lid, so as to abstract some blood, or touch the ulcerations with the solid nitrate of silver, or apply a solution of the latter (half a drachm of nitrate of silver to one ounce of distilled water) with a camel's-hair brush. This application has to be repeated every second day, as long as crusts are found. Some recommend calomel powder, to be sprinkled upon the skin along the edge of the lid, instead of applying mercurial ointment.

If tinea have existed for a long time, or the margin of the lid has become much thickened, lint, steeped in a strong solution of nitrate of silver (ʒj. ad aquæ ℥j.), has been recommended to be tied over the closed lids. The lint should be changed twice daily.

In lippitudo, we slit open the displaced tear-puncta and canaliculi, if epiphora exists. The patients, as a rule, are very nervous, and render this little, but essential, operation somewhat difficult.—[Bader.

ENTROPION.

Entropion, or an Inversion of the Eyelashes,—Is a not infrequent result of injuries of the conjunctiva of the lids, from burns or scalds from lime, mortar, strong acids, or any other escharotic which may have caused destruction of a portion of that membrane.

As cicatrization proceeds, a contraction of the surrounding tissue goes on, to help close up the gap occasioned by the escharotic, and the margin of the lid, with its lashes, often becomes inverted and drawn towards the globe. This folding in of the lashes is a source not only of great discomfort to the patient, but of danger to the eye. The continued brushing of the lashes against the cornea, in every movement of the eye, is apt to induce a troublesome form of corneitis with ulceration, and will invariably, in a short time, render the cornea nebulous and vascular.

Treatment.—If few eyelashes are displaced, they should be drawn out gently with the cilia forceps (without breaking them off). Frequent repetitions of this may produce atrophy of the hair-papillæ. Some recommend the removal of the hair-papillæ by operation.

The growth of fresh eyelashes may be prevented for months, by applying some sulph. hydrate of calcium to that portion of the margin of the eyelid which surrounds the orifices of the eyelashes. The calcium, after five minutes, is washed away with a sponge. During the application, a spatula is placed between the lid and the eyeball, to protect the latter.

The papillæ of the eyelashes may be destroyed with pure liquor potassæ. To do this, a needle, moistened with the liquor, is thrust along the eyelashes, in the direction of, and a little beyond, the papillæ. Slight inflammation follows. The eyelashes, after a few days, are drawn out with the forceps.

There are many operations recommended for the cure of entropion; but when it is dependent on cicatrization following a loss of substance of the conjunctiva of the lids, there is only one way of efficiently dealing with it, and that is, by dissecting out the entire row of lashes. Any other mode of treating this deformity will be only temporary, and, after a while, the lids will again become inverted. As soon as it is noticed that the margin of the eyelid is folded inwards, and the lashes are in contact with the eye, an operation for their removal should be performed, as delay will only give time for the cornea to become injuriously affected by them.

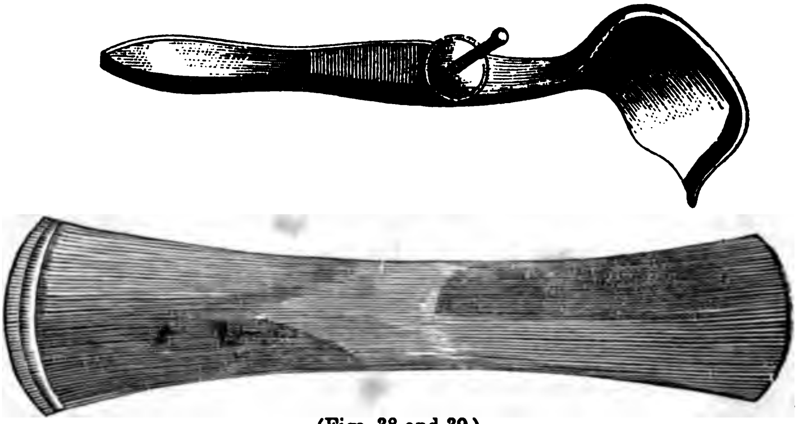
Operation for the Removal of the Eyelashes.—This consists in first splitting the tarsal cartilage, and then excising the thin wedge of it, in which the bulbs of the lashes are imbedded.

The lid being drawn tense by one hand of the operator, with the other he makes a long incision with a cataract-knife along the inner, or ocular, edge of the lashes, and of a sufficient depth for the point of the knife to pass beyond the roots of them. The lid is now to be relaxed, and a second incision is to be made just behind, but parallel to, the row of lashes on the outer surface of the lid, so as to cut through the integuments and the margins of the cartilage just beyond their roots; the depth of the two incisions will thus meet, and the whole row of lashes will be excised.

The cut surface of the cartilage should now be carefully scanned over, so that if any of the bulbs of the lashes have escaped excision, they may be removed; should any be left, new lashes will sprout again from them, and the object of the operation will not be completely fulfilled, as a single eyelash brushing against the cornea may cause a great amount of suffering, and produce considerable irritation. The bulbs of the lashes may be recognized by their appearing as fine black dots.

Lastly, the skin should be gently pressed over the cut edge of the cartilage, and a compress of wet lint be applied to the eye with a bandage. No sutures should be used.

By this operation the lid is not shortened, for the edge of the cartilage is simply split, and the thin wedge of it removed in which the lashes are implicated.



(Figs. 38 and 39.)

To facilitate the performance of this operation, either Snellen's eyelid forceps (Fig. 38), or the horn spatula (Fig. 39), may, when practicable, be used. If Snellen's forceps are selected, the lower blade should be gently insinuated beneath the upper eyelid as far as it will pass, and then, with a few turns of the screw, a metallic clamp is made to compress firmly the circumference of the lid, with the exception of its tarsal border, which is left free for the operator.

The advantages which this instrument offers are:—1st. That the operation, which is usually accompanied by sharp hemorrhage, is rendered by it an almost bloodless one; and, 2d. That, as all bleeding is arrested whilst the clamp is applied, an efficient exploration can be easily made for the bulbs, or any lashes which may have been inadvertently left.

The great disadvantage of this instrument is, that the extreme lashes, both at the inner and outer part of the lid, are often concealed by the rim of metal which is screwed upon them, and that they are thus apt to evade the notice of the operator. This may be avoided by first confining the operation to the parts within the clamp, and by then completing it after the instrument has been shifted first to one and then to the other extremity of the eyelid.

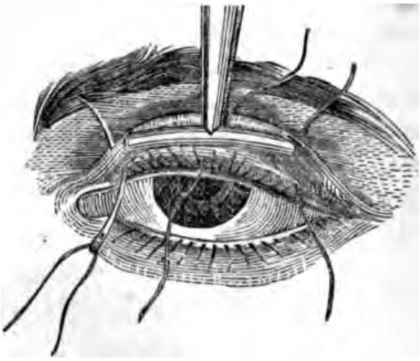
Snellen's forceps are made right and left handed, according to the lid for which they have to be used. These are only applicable to operations on the upper eyelid.

When the horn spatula (Fig. 39) is used, it should be held by an assistant after one of its extremities has been passed beneath the eyelid. It will serve to support and extend the eyelid during the operation.

There are, however, many cases of traumatic entropion where it is impossible, on account of a partial union of the lids to the globe, to use either Snellen's forceps or the horn spatula. In such cases, the plan recommended of making the lid tense by drawing upon it with one of the fingers must be adopted.—[Lawson.

Entropion, if the tarsus is not thickened or distorted by cicatrices, can be remedied *by establishing one or several cicatrices the integuments of the inverted lid.*

As close as possible to the outer edge of the margin of the inverted lid, a needle, armed with strong waxed thread, is thrust through the skin and other soft parts. It is carried along the outer surface of the tarsus, and brought out again, about ⅓ in. from the point where it entered. The distance of these two points from each other, and, with it, the quantity of skin, muscle, etc., enclosed by the thread, must be regulated by the degree of entropion. By pinching up a fold of skin, parallel to the margin of the lid, previously to inserting the needle, we can, in a measure, ascertain how much of the skin, etc., need be enclosed. The thread is tied firmly, so as to strangulate the skin, muscle, etc., and is left to come away by suppuration. This requires from six to ten days. The linear cicatrix, which remains, is expected to keep the lid in proper position. Several of the cicatrices may be required, if the entropion be considerable. The threads have to be removed, if erysipelas appears.



(Fig. 40.)

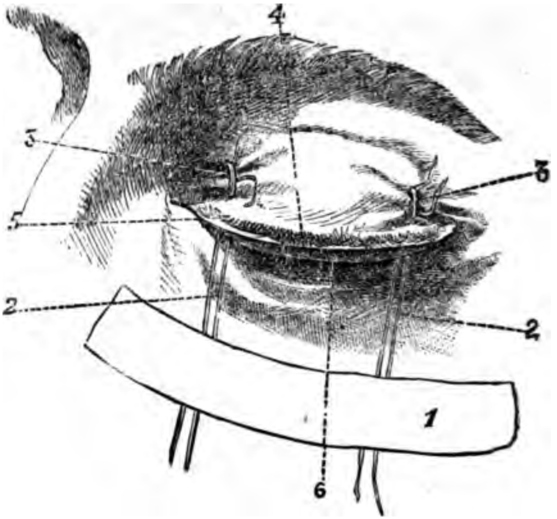
Entropion, Treated by Removal of a Fold of Skin, etc.—The relaxed skin of the inverted lid is seized close to the margins by the finger or forceps, and raised in a horizontal fold, so that the inner edge of the margin of the lid is slightly drawn away from the eyeball. If sufficient skin has been pinched up, the patient, when forcibly closing the lids, will not be able to produce entropion. The fold of skin is then removed by scissors; a narrow strip of the entire thickness of the exposed portion of the orbicularis muscle, about ⅛ in. wide, likewise taken away, close to the margin of the lid.

Two or three sutures are applied to convert the wound surface into a linear incision. Immediately after the operation, the margin of the lid should be very slightly everted. Water dressing is applied for a few days.

Entropion of the lower eyelid, at or near the outer canthus, caused by enlargement and flaccidity of the eyelid, is removed by displacing the margin of the lid, so as to render it less flaccid.

An incision, about ⅛ in. long, and commencing at the outer canthus, is made through the skin and other soft parts horizontally outwards, down to the external palpebral ligament and adjoining periosteum. Two other incisions, likewise extending to the periosteum, the one from the beginning, the other from the end, of the horizontal incision, are carried downwards, and made to meet at an angle, on a level with the lowest point of the lower margin of the orbit.

The soft parts, enclosed by these incisions, are dissected away, and the margins of the two downward incisions are united by sutures. The operation should have the effect of stretching the margin of the lower lid over the eyeball, and keeping it in proper position.



(Fig. 41.)

1. Method of securing the cords which control the levator.
2, 2. Cords holding the levator.
3, 3. Stitches securing proper position of external integument.
4. Ciliary border. 5. Lachrymal punctum.
6. Border of tarsus, projecting below the ciliary margin.

Dr. Joseph S. Hildreth, of Chicago, has devised an operation, somewhat similar to that of Jaesch, only that there is no strip of integument removed from the upper lid, and there is, consequently, no isthmus of integument including the ciliary matrices to be in danger of sloughing. The skin, orbicularis muscle, and ciliary margin, are dissected up from the cartilage, and the skin, with the underlying orbicularis, are maintained in a folded condition, by a suture at either end of the lid, as represented in *3*, *3*, Fig. 41. Then a thread is passed from the mucous side over one border of the levator palpebræ, and, without penetrating the skin, it passes out again through the mucous membrane; another similar thread is passed through and over the other border, in the same way. The threads *2*, *2*, are then brought down upon the cheek, and retained by the plaster, *1*. This is in order to hold down the cartilage, until the integument and orbicularis form a new attachment, high enough up, so that the eyelashes will not again project from the cartilaginous margin over upon the globe.

Saunders proposed to take out a portion of the inferior border of the cartilage; and others have cut off cartilage, eyelashes, and all, as if in despair of affording relief by any conservative method.

The recognition of the contraction of the conjunctiva, and the shortening of the palpebral fissure, has led to the attempt to create a new external canthus, by establishing a fistula by means of a silver wire, and afterwards cutting out between the canthus and the fistula. And again: the canthus has been elongated by incision, and the conjunctiva has been drawn out and stitched fast, as in Dieffenbach's operation for elongating the fissure of the mouth (the 2d variety of the 4th method).

This last expedient fails, because the supply of mucous membrane is already too small for its legitimate purposes, without affording any material for elongating the palpebral fissure. The indication is, to lengthen the palpebral fissure, to diminish the closeness with which the upper lid glides upon the eye, and to enable the operation of Des Marres to evert the eyelid. It is to fulfil this indication, that a new operation is proposed, which, instead of attempting to supply the deficiency out of mucous membrane, supplies it out of skin, by the implantation of integument behind the outer portion of the upper lid; the first variety of the fourth method.

Operation.—From a point in a line drawn horizontally through the external canthus, and about $\frac{1}{16}$ of an inch from the canthus, carry an incision downwards and inwards from one-third to one-half the length of the lower eyelid, and parallel with its ciliary margin. Make another incision, beginning at a point $\frac{1}{8}$ of an inch further out in the same horizontal line, cutting downwards and inwards, and meeting the other incision at its lower extremity.

If the incisions are made by a narrow-pointed bistoury piercing the skin and cutting it out, it is best, in making the second incision, not to bring the point of the bistoury out exactly at the lower end of the first incision, lest the skin should slide over the edge of the knife and make the flap too short. The integument between the incisions, down to the orbicularis, is then dissected up as a triangular flap, beginning at the apex below. The flap is then turned up, and its apex is transfixed with a needle attached to a silver wire, having, also, a needle attached to the other end. This affords a convenient means of holding up the flap. Care should be taken here, as in all cases where it is expected to escape suppuration, to avoid contusion of the flap by the pinch of forceps. It is better not to use forceps at all in this operation, but to lift the point of the flap with a tenaculum, and as soon as sufficient integument is raised, to transfix the flap with the needle, which affords an adequate handle to it.

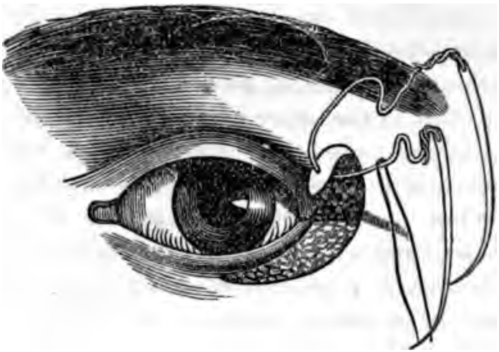
Then, under the base of the elevated flap, an incision is carried in the horizontal line already indicated, through the canthus, deep through the fibres of the orbicularis, down to the bone, and outwards to the upper end of the outer vertical incision. The mucous membrane is then freely incised behind the outer portion of the upper lid, so as to permit the easy elevation and eversion of the lid. The flap is then doubled upon itself, and drawn under and behind the outer portion of the upper lid, being drawn into its new position by the wire suture previously introduced through the flap. To this end, the points of the needles are introduced, about ¼ of an inch apart, behind the outer portion of the upper lid, and brought out through the integument beneath the brow. Care should be taken to introduce the points of the needles in the dissected space, where an open space has been created in the mucous membrane. The object of this caution is to secure the contact of the areolar tissue of the flap, with the corresponding tissue behind the lid, in order to make union possible. The inverted integument thus comes to occupy the position, and to perform the function, of mucous membrane. The wire is twisted over a compress for the protection of the skin from ulceration, and it is left in five days or longer.

For the easy extraction of the silver wire, it is convenient to have put a thread into the loop, before drawing it in. This should be tied down upon the wire, in order that it cannot, by any possibility, become displaced, instead of leaving it loose, as shown in the cut. After cutting the free ends of the loop coming out below the brow, a gentle pull upon the thread which hangs out at the canthus, readily extracts the loop in the direction contrary to that in which it had been introduced.

The two lines bounding the space from which the flap had been taken, are made to meet by a little undercutting of the margins, and retained by interrupted sutures. The nearness to the margin of the lower lid, to be observed in making the first incision, depends upon the amount of eversion to be secured to the lower lid. If there is no inversion of the lower lid, the flap should be taken from a space more distant, and *vice versa.*

The accompanying illustrations, Figs. 42, 43, will render the account more intelligible.

Fig. 42 represents the external commissure, contracted by inflammation. The space from which the flap has been dissected is seen below the outer part of the lower lid, and the flap itself is turned up, with the wire passing through it. A dotted horizontal line shows the place in which the deep incision is made, to extend the external canthus.



(Fig. 42.)

A new operation for entropium, by inverting a portion of the integument of the face behind the upper lid. The flap is seen dissected up.

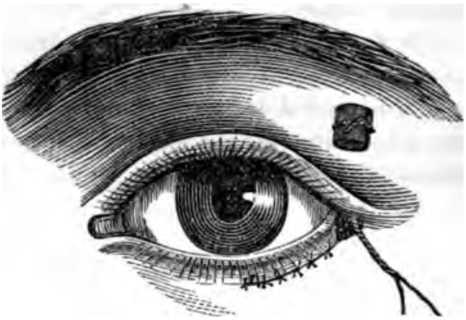


Fig. (43.)

The operation completed. The flap has disappeared, and is retained by a suture tied over a compress below the brow. The space from which the flap was taken is covered by the adjoining integument.

Fig. 43. represents the operation completed. The flap has disappeared behind the upper lid, and the retaining suture passes out under the brow, and is twisted over a compress.

The ligature for the retraction of the suture is seen hanging out at the external angle. The integument adjoining the space from which the flap has been dissected, has been brought together and is retained by interrupted sutures.

In the cases of entropium which require this operation, it will generally be necessary to perform that of Celsus, or Des Marres' modification (the first expedient mentioned in the preceding enumeration), in order more perfectly to effect the eversion of the ciliary margin.

In cases in which chronic inflammation and long-continued granulation have produced a marked diminution of the oculopalpebral fold, the plan of inversion of integument may be applied to both lids. A strip of integument may first be taken from the upper lid, immediately above the eyelashes, after the method of Des Marres, and leaving it attached at its outer extremity, it can be attached behind or within the lower lid; and after the complete healing from this operation, a strip of integument may be taken from beneath the lower lid, in the same way, and implanted behind the upper lid. We thus combine the most efficient means of everting the ciliary margins, with a mode of supplying redundant skin to take the place of deficient mucous membrane. The only deformity which is left by this operation is a somewhat unnatural fulness above the external commissure, which, if desired, can be remedied by a subsequent operation, removing a portion of the integument which had constituted the base of the flap.

It has been suggested, that modifications of this operation may be made for symblepharon, in order to supply, to some extent, the deficiency of the mucous membrane, by implanting the delicate skin of the lids. This is very extensible, so that though a flap, at the time of its implantation, may seem very small, yet it is capable, after its adhesion in its new location, of great enlargment.

To remove any deformity which may arise from the increased thickness, when the flap turns in at either the inner or the outer canthus, the pedicle through which the vascular supply was first maintained may be cut away, after the circulation has been established through the adhesions in the new relations.*

Dr. I. Hays, of Philadelphia,† has secured some success in adhesion of the lids to the globe, by dividing the adhesions, and introducing a metallic plate between the lid and the globe, having it so shaped as to correspond with the curvature of the eye, or like the rim of an artificial eye. This is worn until the cicatrization is complete.

The writer, following this example, introduced a gold plate, with partial success, but there was so much difficulty in keeping it in position, that he determined, if he should have another case, to have a wire soldered near each end of the border, the lower border for the lower lid, and the upper border for the upper, to arm these with needles, and having introduced these deep and brought them out through the integument, to fasten the ends as represented in Fig. 43. It must be practicable, by this means, to hold the plates in position any length of time. The wearing of the plate may be combined with the insertion of a piece of skin, to increase the extent of the internal lining of the lids.—[PRINCE.

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* A description of this operation was published in the *American Journal of the Medical Sciences*, for October, 1866.

† *American Journal Med. Sciences*, January, 1861, page, 116.

ECTROPION.

EVERSION OR TURNING OUT OF THE EYELID.

Ectropion varies in degree, from slight sinking away of the inner edge of the lid, from the eyeball, to complete eversion of the entire lid, and of the adjoining fornix of the conjunctiva.

The conjunctiva, exposed to the air, etc., appears unduly vascular, in recent cases. It gradually becomes hypertrophied and granular. Accumulation of tears, in the sulcus, between the lid and the eyeball, and epiphora, are frequent complications.

The cornea, if continually exposed, becomes vascular. Opacities, infiltration, and ulcers, etc., appear. This occurs sooner in old and weak patients.

Ectropion of the swollen eyelids is observed during purulent and other forms of ophthalmia, especially in children. Its occurrence is favored by the spasmodic action of the orbicularis muscle, or by attempts to inspect the cornea.

Causes.—Cicatrices, from injuries, burns, ulcers, etc., in or near the lids. Shortening or destruction of the skin, or of the skin and suspensory ligament of the eyelids, or of the tarsus.

Atrophy of the orbicularis muscle, from undue extension, caused by protrusion of the eyeball, or by inflammation of the eyelids. Paresis or paralysis of the orbicularis muscle, as frequently seen in old persons.

Acute inflammation of the conjunctiva, with much chemosis, especially if the tarsus has become softened. Long-continued overflow of tears and mucus, causing eczema and contraction of the skin.

Treatment.—During the healing of injuries, burns, or in the course of bone disease, to prevent ectropion, as far as possible, it may become necessary to keep the lids closed, sometimes for two or three months. This is done by the application of strapping; or in cases requiring a prolonged treatment, by producing (temporary) adhesion of the margins of the eyelids.

In slight cases of ectropion, and in those which arise from expansion or relaxation of the tarsus, or from paresis or paralysis of the orbicularis muscle, the palpebral aperture is narrowed by operation. In extreme cases, we may have to perform the same operation at the inner canthus; also, taking care not to disturb the tear-puncta.

Ectropion, arising during acute inflammation of the conjunctiva, often subsides spontaneously. During the inflammation, the lids can be maintained in position by the application of metal sutures, pieces of strapping, or a bandage.

In considering what are the best means of restoring to its normal condition an eyelid which is deformed by ectropion, it is necessary to determine accurately the relative changes which have been produced by it, in the different parts of the lid. 1st. The eyelid is more or less elevated. 2d. As a consequence of this, the punctum lachrymale is displaced: it is drawn away from its proper relationship with the globe, so that it ceased to act as a conduit for the tears. 3d. The tarsal edge of the lid is more or less elongated, according to the extent of the eversion. 4th. In many cases, the exposed conjunctiva is hypertrophied and thickened.

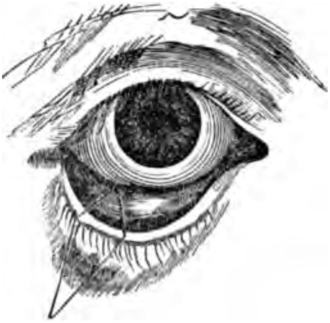
1st. In a mild case of ectropion, these defects will be only slightly marked, and, possibly, one or other of them may be absent; but, where there is a great eversion of the lid, they will probably be all present and distinctly seen. In treating of these defects, I will take them in the order in which it would be wise to proceed in an operation for their relief.

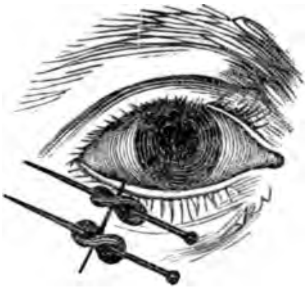
2d. *If the exposed conjunctiva is much thickened and hyper-*

trophied, the prominent excrescent-looking portion should be excised. This is most easily done by seizing, with a pair of fine-toothed forceps, the piece of conjunctiva which is to be removed, and cutting it off with a pair of small scissors, curved on the flat. The contraction which accompanies the cicatrization of the conjunctiva draws the edge of the eyelid inwards, and helps, very materially, to restore it to its natural position.

3d. *When the tarsal edge of the lid is elongated*, it must be shortened, before the lid can be restored to its proper position. This lengthening of the tarsal margin is due to the constant pull which has been exerted upon it, during the contraction and cicatrization of the wound, which has caused the ectropion. To remedy this defect, a V-shaped piece of the edge of the lid, as in Fig. 44, may be excised with a fine scalpel. The lips of the wound are then to be brought together with fine pins and twisted sutures; taking care that one of the needles is inserted close to the tarsal edge, as in Fig. 45, so that an accurate apposition of the corresponding surfaces is secured.

A portion of the tarsal cartilage may thus be removed from any part of its length; but, in most cases, it is advisable to make the excision from the extreme end, close to the outer canthus, taking away, at the same time, sufficient from the edge of its fellow-lid to form a raw surface, with which it may be united. The edges of the wound are brought more easily and accurately together than when the part excised is near the centre of the lid; and the scar which is left is much less noticeable.


(Fig. 44.)

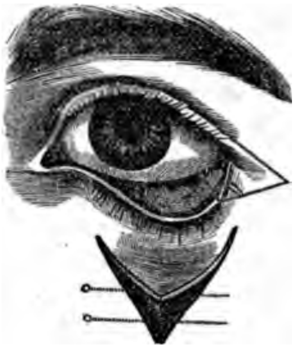

(Fig. 45.)

In shortening the lid, it is always necessary to take away a piece of sufficient size, so as to reduce the palpebral aperture to a little below its normal dimensions.

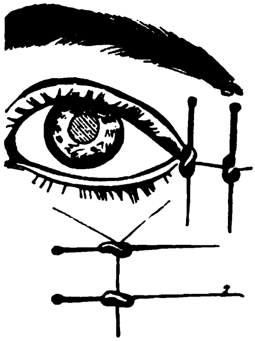
4th. *To relieve the eversion of the eyelid*, many operations have been suggested and practised. When the ectropion depends, as it generally does, in traumatic cases, upon a cicatrix, either of the skin, in the neighborhood of the orbit, or of the lid itself, the first endeavor should be to free the eyelid from the influence of the scar which binds it down. This can be often readily accomplished: the great difficulty is to prevent a reunion of the parts, and a return of the deformity.

Where there is Complete or Partial Ectropion, dependent on a Cicatrix, at a Short Distance from the Lid.—For convenience of description, I will deal with a case in which the lower lid is the one affected: the same plan of treatment, modified according to circumstances, will be applicable to ectropion of the upper lid. If the ectropion is partial, and due to a small cicatrix, which is only adherent to a very limited area of the cellular tissue beneath it, while, around the scar, the skin will glide easily over the subjacent tissues, it will be sufficient, first, to free the deep adhesions of the cicatrix by subcutaneous division. A tenotomy-knife is to be introduced beneath the integument, at a short distance from the scar; and, by a few semicircular sweeps, the union between it and the cellular tissue will be parted. If this is satisfactorily accomplished, the skin will now glide with freedom over the parts to which it was before adherent. The tarsal edge of the lid should now be shortened, in the manner already described; and, if the exposed conjunctiva is much thickened, a portion of it also should be excised. By these means, the lid will be restored to its normal position, and, as the scar will be lifted from its original site, the chance of its reuniting to the parts from which it has been severed will be diminished. In the daily dressing of the wounds, the lid should be well supported with a pad of lint, to prevent the cicatrix being again drawn down to its former position.

If the Ectropion is severe, and the Cicatrix, which has caused it, is dense and firmly attached to the subjacent cellular tissue, a different proceeding must be adopted. One very excellent mode of treatment is, by including, in a V-shaped incision, the cicatrix, which is to be separated, by a few strokes of the scalpel, from all its adhesions to the underlying parts, as is well shown in Fig. 46.



(Fig. 46.)

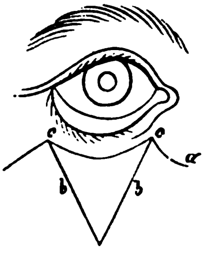


(Fig. 47.)

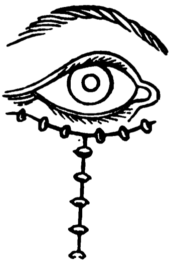
The triangular-shaped piece of skin, in which is the cicatrix, is then to be pushed upwards, whilst the lower edges of the V wound are united by two pins and twisted sutures, in the situation marked by the dotted lines in the wood-cut so as to convert the V, when the parts are brought together, into a Y. The everted lid will thus be raised; but, in order to keep it in position, its tarsal edge should be shortened at the outer canthus, removing, at the same time, a small piece of the margin of the upper lid, to which the lower one should be united by pins and twisted sutures. If the conjunctiva is much thickened, a portion of it may be excised, before shortening the lid.

Fig. 47 shows the appearance the eye will present after the operation is completed.

The following operation was the one recommended and performed by Dieffenbach for the relief of ectropion of the lower lid, which had been caused by a cicatrix, at a short distance beneath it:—He first dissected out the cicatrix by including it in a triangular incision (Fig. 48), the base of which corresponded with the tarsal margin of the lid. Having removed this triangular flap of skin, he then extended the cut *c c* to *c a*, *c a*, to



(Fig. 48.)



(Fig. 49.)

allow of the ready approximation of sides *b b;* which, having been first raised from the subjacent parts by a few strokes of the scalpel, he brought together and united by sutures, as in Fig. 48, the two lateral incisions, *c a*, *c a;* he then fastened, by sutures, to the integument, beneath the lower lid, in the line *c c*. Fig. 49 represents the appearance after the operation was completed. —[LAWSON.

Formation, by Operation, of an Entire Eyelid, or of Part of an Eyelid.—We first ascertain whether any part of the eyelid remains. Though the skin and muscular tissue may have been destroyed, we often find that the tarsus, or part of it, with some altered conjunctiva, has been preserved. In such cases, we free the distorted or everted tarsus from adhesions, place it in a natural position, and unite it by sutures with the opposite eyelid. The union is maintained until the tarsus is covered with cuticle, and all tendency to contraction has disappeared.

Cases of supposed complete destruction of the upper lid, in which large and deep cicatrices, over the forehead and temple, rendered the success of transplantation of skin very doubtful, have thus recovered, with preservation of sight and useful upper lid.

In transplanting skin from adjoining parts on to the replaced tarsus, or in forming an entire eyelid out of transplanted skin, the following rules should be observed:—

(1.) For a lower lid, the skin should be taken from near the ear; for an upper lid, from the forehead and temple; and, in either case, from a part as near as possible to the spot where it is wanted.

(2.) The portion of skin to be transplanted should be as sound as can be obtained.

(3.) The flap of skin should be considerably larger, in all its dimensions, than the surface we wish to cover. The shape of the desired eyelid should be traced on paper, cut out, and placed upon the part from which we propose to take the flap. We then mark upon the skin an outline similar to that of the paper, the lines running parallel with the margins of the paper, but describing a space which, as regards size, is, at least, as large again as the paper. The skin flap, in fat persons, should be still larger.

(4.) The base or bridge which connects the flap with the surrounding skin should be broad. The flap, however, should have sufficient mobility to allow of its being sufficiently displaced, without being too much stretched.

The flap is secured in its new position by sutures, and the after-treatment conducted upon general surgical principles. Warmth should be applied, if the flap has been taken from anæmic cicatrized skin; cold, if the swelling and redness are considerable, and the sensation of cold is pleasant.

SYMBLEPHARON.

Symblepharon signifies adhesion of the conjunctiva of the eyelid to that of the eyeball.

We distinguish—

(1.) *Anterior symblepharon, i.e.*, adhesions of the conjunctiva of the lids to different parts of the surface of the eyeball, by means of vascular or non-vascular bands. The entire conjunctiva of the lower lid may be found adherent to the eyeball. The conjunctiva of the upper lid is rarely adherent throughout.

Extensive adhesions of this kind have been separated successfully, by means of scissors and a grooved director. If the entire conjunctiva, of one or both eyelids, is adherent to the eyeball, a stout lead wire should first be thrust through the adhesion, in the direction and situation of the fornix of the conjunctiva.

This is left until the walls of the channel, thus formed among the adhesions, have become cicatrized. It is then withdrawn, and the rest of the adhesions are divided by means of scissors. The lids are kept everted by a suture or bandage until the wounded surface has become cicatrized. It may become necessary to split the outer canthus, in order to produce and maintain a more complete temporary eversion of the lids.

Bands, extending from the margins of the lids to the eyeball, are dissected from the latter; and a needle, armed with silk, is passed through those portions which were attached to the eye. The needle is carried through the lid from within outwards, close to the margin of the orbit, and the silk is fixed upon the skin. The band is thus drawn in the same direction, and its smooth surface is caused to lie next the eye. In this manner, reunion is prevented.

If this mode of treatment cannot be adopted, the band is divided, close to the eyeball. After cicatrization of the wound, the edges of which must be prevented from reuniting, the band is removed from the lid, unless it has shrivelled away spontaneously. If the cornea is implicated, an opacity may remain; though opacities, occupying half of the surface of the cornea, may gradually disappear, after removal of the adhesions.

Syncanthus signifies a symblepharon at the inner canthus, complicated with destruction of the caruncle and of the semilunar fold.

(2) *Posterior symblepharon, i.è.*, shortening of the conjunctiva, caused by shrinking of the fornix alone, or by adhesions between the fornix and the adjoining palpebral and ocular conjunctiva, is of no consequence, if slight. If extensive, it impairs the mobility of the eyeball, gives rise to entropion, etc. It is, at present, considered incurable.

Anchyloblepharon signifies adhesion of the margins of the lids to each other, by means of membranous bands, extending from the edges of one eyelid to those of the other. This generally occurs at or near the outer, rarely at the inner, canthus. The adhesion may be divided, and the wounded surface, after bleeding has ceased, painted over with collodion.

Anchylosymblepharon signifies adhesion of the margins of the eyelids to each other, and to the ocular conjunctiva.

Blepharophymosis signifies *narrowing of the palpebral aperture.*

The outer palpebral ligament and the other parts which contribute to the formation of the outer canthus appear thickened, and often inflamed. The causes are:—shrinking of the conjunctiva, after injuries, after loss of the eyeball, after protracted tinea, and especially after protracted granular ophthalmia, with pannus.

Blepharophymosis gives rise to entropion, eczema, and epiphora, and to more or less blepharospasmus.

Operation for Blepharophymosis (*Enlargement of the Contracted Aperture of the Eyelids*).

The eyelids are kept open by a strong wire-speculum, and the outer canthus is thus put on the stretch. With scissors, or with a scalpel, a horizontal incision, about half an inch in length, is carried through the outer canthus, outer palpebral ligament, and orbicularis muscle, down to the outer angle of the orbit. The edges of the incision are then drawn widely asunder, and the conjunctiva is united, by sutures, to the nearest portions of skin.

Some of the conjunctiva is thus interposed between the fibres of the orbicularis muscle, and slight ectropion is produced.

Tarsarophy.—Union, by operation, of any portion of the margin of the tarsus of the upper to that of the lower lid.

The tough texture of the tarsus, the great pain felt on wounding it, and the profuse bleeding which always occurs, render it advisable to administer chloroform.

With a sharp cataract-knife, or, better, with a lancet-shaped knife, we remove, from the upper and lower lids, those portions of the inner edges of the tarsi which lie opposite to each other. None of the eyelashes need be removed. The wounded parts, when the lids are closed, should be opposite each other. The lids are united by passing a suture beneath the wounded surfaces; the needle being carried close to the margin of the wound through the conjunctiva, tarsus, and skin.

The lids of both eyes are kept closed and at rest for thirty-six hours, when the sutures may be removed.

The inner and outer canthus, and any portions of the margins of the lids, may be thus united.

WOUNDS.

The cut edges of a wound, however large, if fresh, or not yet granulating, should be carefully united by sutures. Care should be taken to prevent the tear-puncta from becoming closed or displaced, if the wound should happen to be near them.

If the wound is already granulating, strips of sticking-plaster should be applied, so as to secure a natural position of the lid, while the wound is healing. Any displacement of the lid is to be remedied afterwards.

Ecchymosis, or suffusion of the lid with blood, whether the result of a blow, of leech-bite, or of an operation, should be treated by the application of a poultice, made of the scraped root of black bryony (Bryonia nigra), mixed with equal portions of linseed meal, or bread-crumbs. The poultice, spread between pieces of linen, is placed upon the closed lids, and left on as long as the patient can bear it. Several poultices may have to be applied in succession. Ecchymosis of the lids, following excision of the eyeball, causing extreme swelling and dislocation of the lids, disappears completely, after applying such poultices for from one to three days. An "almost unbearable stinging sensation" accompanies the disappearance of the suffusion.

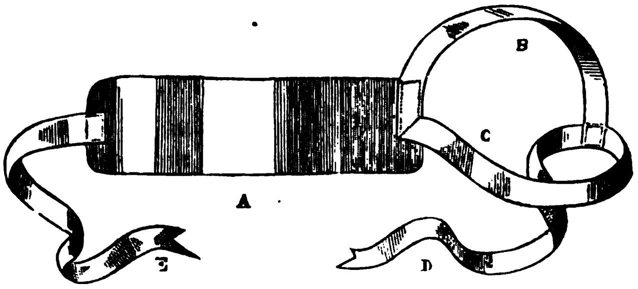
Some recommend fomentations with hot water, instead of the poultice.

Emphysema of the lids results from fracture of the bony wall of the nasal cavity, with laceration of the lining membrane. The air passes beneath the skin of the lids, when the nose is blown. When this is done, the lids become suddenly swollen, without changing color. On percussion, a clear sound is heard, and, on touching with the finger, a crackling of air is felt, as when squeezing an emphysematous lung. Lint, with cotton-wool, is applied over the closed lids, so as to cause slight pressure, and the parts are kept at rest for some days.

EYE BANDAGES.

Liebreich's Eye Bandage.—After all operations on the eye, but especially after an extraction of cataract, the comfort of the patient is increased, and the prospect of success improved, by an easy, well-adjusted bandage. The one now in use at the Royal London Ophthalmic Hospital fully accomplishes its purpose; it was introduced by Dr. Liebreich, about three years ago, when on a visit to the hospital.

Fig. 50. is a close representation of it; the only difference between the original bandage and that in the drawing is a slight modification in the way in which the tapes are fastened to the knitted band. The bandage consists of a knitted cotton band, *A*, from 11 to 11½ inches in length and 2½ inches in width, at either end of which are attached tapes, to keep it in position on the head. The tape should be 1 inch in width. One tape, *B*, 12 to 12½ inches in length, passes across the top of the head from ear to ear; whilst the second tape, *C*, 10½ to 11 inches in length, goes across the occiput from the ear to the other, and terminates in a free end, *D*, by which it is tied to the tape, *E*, and fastened on the head.



(Fig. 50.)

The patient having been told to gently close the lids of both eyes, a small, single square of linen is laid over the one which has been operated on; upon this is placed a little cotton-wool, and over the whole, and across both eyes, the bandage, which is to be tied on the side of the head, *opposite* to the eye which has undergone the operation. The advantages which this bandage has over the many different methods which are practised for keeping the eyes closed after operations are:—

It is easily applied, and fits accurately, without slipping; it can be unfastened quickly, and the eye examined without disturbing the patient, or without requiring him to sit up, if he is lying down. It is also very easy to the patient, and it does not exclude the use of moist applications to the eye, as they can be applied through the bandage.

I have lately had the bandage made with linen, instead of a knitted band; and, in some respects, I prefer it, as it is not so hot to the eyes; and, if water-dressing or lotions have to be used, they can be more conveniently applied through the linen than the knitted cotton. When moist dressings are required, the cotton-wool should be omitted, and, in its place, a double fold of linen should be laid upon the closed lids, over which the bandage is to be fastened.

INSERTION OF A SETON INTO THE TEMPLE.

The patient is seated, with his head well steadied against the surgeon's chest, who stands behind him. The surgeon, to avoid wounding the temporal artery, first ascertains its pulsation beneath the skin. He then pinches up a fold of skin, between the outer margin of the orbit and the artery, and thrusts the seton-needle, armed with stout silk thread, through the entire thickness of the skin, on the side of the fold next the ear, pushes it on in a vertical direction beneath the skin, along the base of the fold, and brings it out about an inch and a half higher up. The silk thread (seton) thus lies close in front of, and somewhat parallel with, the temporal artery. The needle is removed, and the silk securely tied into a loose loop, to allow of its being moved to and fro. The hair being placed over it, hides it from view.

Bleeding beneath the skin sometimes occurs, causing considerable swelling, if the temporal artery has been wounded. The seton should be removed at once, to arrest undue loss of blood, if the escape of blood is profuse and of arterial character, or if it does not discontinue within half an hour. Another seton may at once be placed into a part of the skin beneath which the hemorrhage has not extended.

The patient or nurse must be shown how to move the seton to and fro: this should be done once daily.

The seton gives rise to inflammation of the surrounding skin, and purulent discharge, which latter should be carefully cleansed away with warm water, twice daily.

The discharge may cease before the seton has had the desired effect, if the tract through which the silk passes becomes cuticular.

Insertion of a seton into another part of the skin, or application of some irritating ointment to the first one, should be tried.

Large granulations, or much swelling of the skin, need not alarm us. The seton may be removed after the intolerance of light and corneitis have subsided. A new one must be introduced (through the original tract, if possible), if the first should fall out accidentally. The openings in the skin, after removal of the seton, gradually approach each other, and frequently coalesce, leaving a hardly perceptible cicatrix.

The seton is of the greatest use in opacities, pustules, and ulcers of the cornea, when accompanied by spasmodic closure of the eyelids, increased vascularity, lachrymation, and intolerance of light, where granulations of the conjunctiva are not present simultaneously.

It may be inserted at any age, and is, in hospital practice, almost the sole remedy adopted for the rapid removal of the disturbances accompanying the just-mentioned corneal changes.

LEECHES.

If ordered for the purpose of acting upon the eye, are applied to the skin of the corresponding temple.

Instillation of atropia increases their effect.

The eyes should be kept closed during the bleeding, and for some hours after it has ceased. Evening is the best time for the application of leeches.

The bloodvessels of the choroid (viewed with the ophthalmoscope, during the application of leeches) at first become contracted, then dilated, then contracted again, within their usual diameter, and finally dilated again to their normal calibre.

TURNBULL'S PRACTICE.

My first experiment was undertaken in 1837, with the diluted acid, by dipping a sponge into it, and rubbing it upon the forehead for the space of a few minutes, which gave the skin a very red appearance; but the patient experienced not the least sense of heat, and the pupil was slightly dilated. I continued to use this, with very beneficial effects, in incipient cataract, opacities of the cornea, inflammation, amaurosis, iritis, etc. Of late, instead of the diluted acid, I have applied the *vapor* of the concentrated acid to the eye with much more decided effect, and without the slightest danger. The plan I generally adopt is, to put into an ounce phial a drachm of the acid, and hold it in close contact with the eye, the eyelid being open for the space of about half a minute, or until such time as the patient feels a little warmth, or the person holding the phial sees the pupil greatly dilated, and the vessels of the eye injected with blood, which is the invariable effect of the application of the acid. The patient is not sensible of pain, from this peculiar state being induced; which appears to me to result from the powerfully sedative influence of the acid; thereby showing, that two opposite powers—to wit, the stimulating and the sedative—are exerted at the same time; and thereby the uneasiness, arising generally from a stimulant alone, is prevented. Its great power in removing these diseases chiefly arises from the two powers being so blended, and thus enabling the eye to bear a sufficient stimulating action, without injury. The person who holds the acid to the eye should *be careful not to allow the patient to smell it.*

The *Medical Gazette* and the *Lancet* gave insertion to the following statement of mine, of date October 20, 1842:—

"SIR,—In October, 1841, I gave an account of the action of the vapor of *hydrocyanic acid* upon diseases of the eye. Since that period I have been engaged in investigating the action of various other bodies on the same organ, and under the same form.

One reason why I did not rest satisfied with the effects produced by the hydrocyanic acid, was, that its action, like that of all other medicines, decreased in power by continued application; thereby rendering it necessary to have occasional recourse to other medicines, in order to insure a more speedy recovery. Another reason was, the reluctance of many individuals to submit the eye to the action of so potent a medicine.

The first medicines to which I shall refer, and which I have employed with some success, are: the *chlorocyanic acid*, and *sulphuretted chyazic acid*. The plan I pursue is that of putting a drachm of one of the medicines into a bottle (containing a small piece of sponge) of about two-ounce size, having a mouth precisely fitted to the eye, and with a ground-glass stopper.

The action of these medicines is very different from that of the *hydrocyanic acid*, in as far as they both stimulate the eye, and produce much greater warmth and irritation, with less dilation of the pupil. Few, however, can bear the chlorocyanic acid to be applied longer to the eye than half a minute; though, in a minute after its application, all irritation is removed, and the eye feels perfectly at ease.

The next medicine which I have employed in the form of vapor, was the chloruret of iodine. This medicine produces very little warmth or uneasiness to the eye, if continued for the space of two minutes or upwards, but a sensation of irritation, accompanied with a flow of tears, takes place on its removal. It contracts the pupil, and in no case have I seen it dilate it. Its vapor rises very readily, and does not leave the yellow, disagreeable coloring on the skin, produced by the vapor of iodine, when uncombined; which is a great drawback in the use of iodine in diseases of the eye.

The last medicine which I have employed is the bisulphuret of carbon, which is so volatile that the application of it to the eye, when the bottle is held in a warm hand for a few seconds, is as much as can be borne, in consequence of the intense prickling heat and flow of tears which it occasions. Owing to this fact, I generally use it by causing the patient to shut the eyelid during its application, which can then be continued for a minute or two, with the same beneficial effect upon the eye, without inconvenience to the patient. It generally contracts the pupil, and very seldom dilates it.

I used to employ iodine by putting it into the same bottles, and immersing it in hot water, and, in its state of vapor, applying it to the eye: but I find it answers much better when dissolved in the bisulphuret of carbon.

It may not be out of place here to state, that I have employed, with great success, the bisulphuret of carbon, to enlarged indurated lymphatic glands. In the first instance, I rubbed equal quantities of the bisulphuret of carbon and alcohol upon the parts affected, but without any effect upon the glands. But as its effects were so great when its vapor was confined to the eye, I was led to apply it in the form of vapor, and by means of glass bottles similar to those I have described. By these means I excluded the action of the medicine from the external air, and thereby prevented its speedy evaporation. When it had been applied about one minute, the patient felt the part very cold, but, immediately after, a gradual heat, accompanied with great prickling; the heat increasing the longer the medicine was kept in contact with the part, until it could be no longer endured. On removing the glass, the part was red to an extent two or three times greater than the part enclosed. In a few days, the change in the size of the glands was very great; and, by its daily repetition, a complete and speedy removal of the disease was effected. I also find that its action upon diseased glands is more decided, if the surface of the skin is well moistened with water, previous to the application of the bottle to the part.

The water, in fact, not only prevents the escape of the vapor between the glass and the skin, but assists the imbibition of the carbon; a point of the highest importance, inasmuch as all its action on the part depends upon the exclusion of the atmosphere from the vapor. I may here observe, that these applications occasion no injury whatever to the skin.

I have also found the bisulphuret of carbon and the chlorocyanic acid valuable medicines in the removal of deafness, depending upon a want of nervous energy and deficiency of wax. The mode of its application is substantially the same as that which I employ in diseases of the eye, with this difference only, that the bottle is formed with a small neck and stopper, adapted to the size of the orifice of the ear, and held close to the organ, until a considerable degree of warmth is produced.

The action of those medicines, which contain so large a share of carbon, arises from the carbon, in the vapor, permeating the cuticle, and coming in contact with the oxygen in the vessels, which is conveyed through every part of the frame, by inspiration and otherwise; and thereby forming carbonic acid gas, which evolves heat in the ratio of the quantity consumed by the oxygen.

But, in drawing my remarks to a close, at this time, I cannot refrain from saying less in regard to the utility which is likely to arise from this medicine, when properly applied, than that, in such a similar case as I have stated, I would not for a moment hesitate again in giving it, and the extract of belladonna, a fair trial, so convinced am I now, after applying it pretty freely, by itself, in different affections of the same organ (in all of which more or less improvement of vision was manifested), of its potency to remove many of those formidable diseases of the eye, more especially that of the cornea, which are so often the opprobrium of our art. However, before I have done, it is but justice to ascribe this noble discovery to Dr. Turnbull, whose indefatigable research has not failed to find out others, no less wonderful in their effects, as they are useful to mankind; and, for such, he cannot but claim to himself the best thanks of the profession at large.

ON THE ACTION OF ESSENTIAL OILS, ETC.

In October, 1835, a paper of mine appeared in the *London Medical and Surgical Journal*, stating the beneficial action of a concentrated tincture of capsicum for diseases of the eye, by rubbing it, for a few minutes daily, over the forehead and temples with a sponge.

Soon after this, I was induced to try what effect essential oils, possessing powerful stimulating properties, might possess in removing amaurosis and diseases generally of the eye. The formulæ which I use are—

EMBRO. CARYOPH. CO.

℞.	Ol. Caryoph., Ol. Lavand., } āā,	ʒiv.
	Ol. Cinnamom.,	ʒss.
	Sp. Vin. Rect.,	℥iij.

M. Ft. Embro.

EMBRO. PIMENT. CO.

℞.	Ol. Piment., Ol. Rosmar., } āā,	℥ss.
	Ol. Cinnamom.,	ʒss.
	Sp. Vin. R.,	℥iij.

M. Ft. Embro.

Finding great utility to arise from the use of the cloves and pimento, it appeared by no means undesirable or hopeless to administer them internally for the same complaints. In order to shield the pungency of these oils, I united them with calcined magnesia, which, by its very strong affinity with these essential oils, forms a body nearly solid; and thereby removes all pungency, warmth, and even smell; for, in this state, it requires to be held in the mouth for a considerable time before it produces any warmth or pungency. They are thus rendered easily taken, in sufficient quantity, without heat or uneasiness.

Some children are the subjects of many diseases of the eye, producing blindness, from opacities, etc. I ordered the same to be made into a powder, in which form it can be easily taken in any vehicle, without exciting disagreeable warmth. The formulæ are—

PIL. CARYOPH. C.

℞.	Ol. Caryoph., Magnes. Cal., } āā,	ʒj.
	Ol. Cinnamom.,	gtt. vj.

M. Ft. Pil. xxiv.

PIL. PIMENT. CO.

℞. Ol. Piment., } āā, ... ʒj.
Magnes. Cal., }
Ol. Cinnamom., ... gtt. vj.
M. Ft. Pil. xxiv.

The dose of these pills is one or two, thrice a day.

Expedition is required in the making of these pills; otherwise, it becomes a solid mass, and unable to be formed into pills.

I have found an alcoholic extract of clovers and pimento, made into pills, with magnesia, equally efficacious.

PULV. CARYOPH. C.

℞. Ol. Caryoph., } āā, ... ℥j.
Magnes. Calc., }
Ol. Cinnamom., ... ʒj.
M. Ft. Pulv.

PULV. PIMENT. CO.

℞. Ol. Piment., } āā, ... ℥j.
Magnes. Calc., }
Ol. Cinnamom., ... ʒj.
M. Ft. Pulv.

The dose of these powders is from four to eight grains, thrice a day.

In the making of these powders, the oil and the magnesia ought to be well mixed, and allowed to remain for half an hour; then reduce the mass to fine powder, and keep it in glass bottles with stoppers.

These medicines, by their local application, increase their circulation, and give a greater supply of blood to the deficient organs; and thereby produce natural tone and power. They are equally useful in removing chronic diseases, where thickening and opacity have taken place, by rousing into activity the absorbent and nervous influence by their stimulating power. Among many others possessing the same power, is a concentrated tincture of pepper, nigrum, ginger, etc.

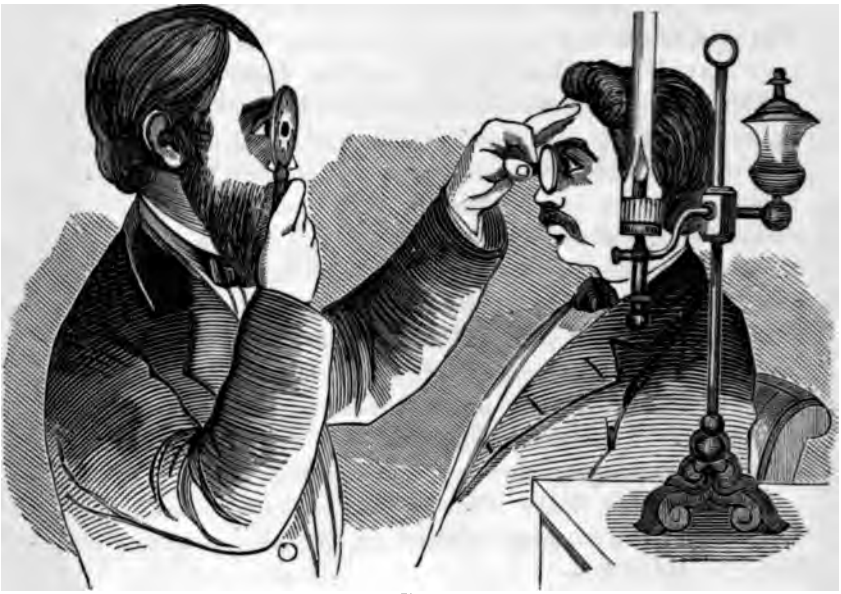
The internal administration has been found much more serviceable in chronic diseases of the eye, such as opacities, etc., than in amaurosis.

The manner of using the embrocations is, by rubbing the forehead and temples with a sponge saturated with the liquid. This plan alone, kept up daily, is beneficial; but the efficacy is more than doubled, if another sponge, with warm or cold water, is rubbed upon the forehead, for a minute afterwards. By this, the energy of the medicines in inducing a free circulation is greatly augmented, and greater warmth is rapidly developed. The *rationale*, in my opinion, is, that the large quantity of carbon in some of the essential oils, and its solubility in alcohol, permits it, by the friction, to pass through the cuticle and unite with the oxygen. As the oils are very insoluble in water, and as the alcohol has a strong affinity for the water, the carbon is more readily disengaged, and forms a union with the oxygen, in the vessels; and thereby produces heat and great activity of circulation. I have no doubt that is the reason why many bodies are so pungent, when put into the mouth.

It will be seen, in the following extract from Tyrrell on the Eye, "functional amaurosis arises from a deficient supply of red blood." He says:—

"In these cases there always exists, I believe, a want of general power and vigor of circulation, at first; but, in some instances of long-continued affection of this kind, the local circulation never regains its proper force and fulness, and the supply of blood is inadequate to support the functions of the part, although the general system recovers its natural tone and power."

I think this statement very correct, and, therefore, the embrocations producing so much additional circulation, point out, at once, the essential oils, along with the water, as its proper remedy. I here quote Magendie, who corroborates the plan which I adopt—*viz.*, the medicines being most useful when applied to the forehead and temples, in amaurosis.



(Fig. 51.)

EXAMINATION WITH THE OPHTHALMOSCOPE. (=O.S.)

The instruments necessary for the examination are: an ophthalmoscope and a spherical lens.

The ophthalmoscope consists—(*a.*) Of a slightly concave, circular mirror, of a focal length of from 12 to 15 inches. The mirror should have a diameter of about 2 inches, and be mounted in a light frame of tortoise-shell, horn, or gutta-percha, with a broad rim, to admit of its being held securely. (*b.*) A circular portion

(*a.*) Among the great variety of ophthalmoscopes must be mentioned: the Binocular Ophthalmoscope, the Anto-Ophthalmoscope, for examination of one's own eyes, the Ophthalmoscope with micrometer, etc., fixed on a stand, and the Ophthalmoscope for viewing the image reflected from the interior of the eye in a second reflecting surface.

Any good light-reflecting surface may be used as an ophthalmoscope, as long as the observer is placed in a position to receive the light returning through the pupil of the examined eye into his own. The ophthalmoscope described above answers all practical purposes.

(*b.*) More light is gained by not having a hole bored through the glass, to (diameter about one-sixth of an inch) of silvering is removed from the centre of the mirror. Thus a sight-hole is obtained. (*c.*) To this corresponds an opening of equal size in the frame.

The spherical convex lens should have a focal distance of from 2 to 3 inches. It should be mounted in the same material as the ophthalmoscope, with a broad rim, so that when laid flat upon a table, it rests upon the rim, and does not become scratched.

Position of Observer and of Patient.—(*d.*) Both are seated in a dark room, facing each other. The eyes of the observer should be level with, or an inch or two above, those of the patient. (*e.*) A gas-light is placed at the side and somewhat behind the patient's head and level with his eyes, so that no light, but that which is reflected by the ophthalmoscope, falls upon the eyes.

Mode of Examination of the different Parts of the Eye.—Every ophthalmoscopic examination should be preceded by the examination with lateral illumination. All alterations in the appearance of the deeper parts of the eye, arising from anomalies in front of the vitreous chamber (in the cornea, lens, etc.), can, with the greatest accuracy, be recognized, if the ophthalmoscopic examination is preceded by that with lateral illumination. This is followed by examination of the vitreous chamber.

For the direct ophthalmoscopic examination (or for the ex-

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establish the sight-hole; and the direct ophthalmoscopic examination is much facilitated.

(*c.*) Attached to the back of the frame of the ophthalmoscope, used at the Eye Infirmary, is a contrivance which may be used as a handle, thus facilitating manipulations with the ophthalmoscope; but which is principally intended for receiving any spherical or other lens we may wish to place there for more minute ophthalmoscopic examination.

(*d.*) Both may stand, or one or both be seated, or the patient lie down, or the observer stand behind the patient, and view the image of the optic disk, etc., received upon a piece of glass, mirror, etc., which is held in front of the patient's eye, and receives the rays of light which return from the interior of the eye.

(*e.*) The gas-light, by placing round it a pale-blue glass, becomes whiter and less troublesome to the observer. Any light, the flame of a candle, etc., may be used. Amaurotic persons are best examined by sun-light.

The ophthalmoscopic examination may be carried on in a light room, as long as sufficient light is thrown through the pupil of the eye under examination, to distinguish the details of its optic disk, etc.

amination of the erect image), we require the ophthalmoscope only. By this method, we obtain a correct view of the color and relative position, and also a much enlarged view of the parts examined.

For the indirect ophthalmoscopic examination (or "the examination of the inverted or aërial image"), we make use of the ophthalmoscope and of the spherical convex lens. We can overlook more parts at one glance, but we see them inverted; *e.g.*, what appears as the upper margin of the optic disk is, in reality, the lower one, etc.

Examination of "the Inverted Image," or Indirect Ophthalmoscopic Examination.—Suppose we wish to examine a healthy right eye, with blue iris, the pupil being dilated by atropia (*f*), and the observer, patient, and the gas-light, being placed as directed above: we take the ophthalmoscope in the right hand, grasping its margin with the thumb and forefinger, as is shown in Fig. 51, and turn the reflecting surface towards the patient. We "throw" the light upon the right eye, and approach the eye with the ophthalmoscope, until the circular surface of light on the patient's face has nearly the size of that of the ophthalmoscope. We must take care continually to keep the circular surface of light on the patient's eye, while raising the ophthalmoscope to our own right eye. When looking through the sight-hole, we perceive the patient's pupil to appear brilliant red instead of black.

If it appears black, we either do not throw the light upon the pupil, or we do not look through the sight-hole of the ophthalmoscope.

Supposing we have obtained the red reflection from the pupil, we at once look for the optic disk, which is most quickly found (the ophthalmoscope being held by the thumb and forefinger) by holding up the little finger of the same hand; and directing the patient to look at the tip of it. The centre of the yellow

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(*f*.) A solution of a quarter of a grain of sulphate of atropia to half an ounce of distilled water is used. The optic disk and the tunics, where immediately adjoining it, can, with very few exceptions, be examined without the use of atropia.

spot of the patient's right eye is thus directed to the tip of that finger, and the optic disk comes to stand opposite the pupil. A change in the color of the reflection from the pupil, from red to whitish-red or brilliant white, indicates that the optic disk is in view. The observer should persist in his endeavors, until he has obtained the brilliant whitish reflection. In persons with dark irides, the difference in the reflection from the pupil is still more striking, on account of the contrast of color between the optic disk and the tunics.

Having obtained the reflection peculiar to the optic disk, we place the convex lens (holding it between the forefinger and thumb of the left hand) before the eye under examination. The diffused image of the flame, which is "thrown into the eye" by the ophthalmoscope, serves to illuminate those parts of the interior of the eye which lie within the area of the flame. The rays of light reflected, *e.g.*, from the optic disk thus illuminated, have to pass through the lens held in front of the patient's eye, and an everted, defined image of the optic disk, etc., is formed in front of this lens, *i.e.*, between it and the observer.

In this case, we do not directly examine the optic disk, but only its inverted aërial image; hence the term examination of the inverted image by the indirect method, or indirect ophthalmoscopic examination.

The little finger of the hand which holds the lens is placed on the patient's cheek, to steady the lens, while the middle or ring-finger is kept disengaged, to be placed, if necessary, upon the margin of the upper lid, so as to raise it, or gently to press upon the eyeball, to produce and watch the pulsation of the retinal artery in the optic disk.

The spherical convex lens is held at from one to two inches from, and somewhat obliquely in front of, the patient's eye.

If the lens is held vertically, the image of the ophthalmoscope, which appears upon each surface of the lens, at its centre, interferes with the view of the part beyond. If the lens is held obliquely, the two images recede from each other. By approaching the lens to, or removing it from, the eye under examination, we soon succeed in obtaining a distinct view of the well-defined (aërial) image of the optic disk, etc.

This image can be enlarged by our placing behind the sight-hole of the ophthalmoscope a convex lens of greater focal distance (one of from 10 to 20 inches focal distance).

After having seen the optic disk, we proceed to the examination of the region of the yellow spot (see *Retina, Examination of the*), and then to that of the more peripheral parts of the tunics, by directing the patient to turn the eye in different directions, while the ophthalmoscope and convex lens remain unaltered in position.

Examination of the "Erect Image," or by the Direct Method, or Direct Ophthalmoscopic Examination.—The gas-light is placed more at the side, and level with the left eye, supposing again that we examine the right eye. We direct the patient to "look straight out," and sitting, or better, standing, in front, we look for the place occupied by the optic disk.

The optic disk occupies a portion of the interior of the eye, situated internal to, and a little below, the yellow spot.

As soon as we perceive the reflection peculiar to the optic disk (and not before), we should slowly approach the eye from a distance of from 12 to 15 inches, taking care continually to throw the light through the pupil, and not to lose sight of the reflection peculiar to the optic disk. On approaching very near the eye, only a small (the central) portion of the ophthalmoscope remains available; and some practice is required so as continually to illuminate the interior of the eye. As long, however, as we do not lose sight of the reflection peculiar to the disk, we may be sure that we are handling the ophthalmoscope properly.

From the degree of distinctness with which we see the optic disk, and the bloodvessels in it, while approaching the eye, we can form a general idea of the refraction (of the shape) of the eye. If the optic disk appears *the more distinct the nearer we approach the eye*, we pronounce the eye to be too short (hypermetropic); if the optic disk appears *the more indistinct the nearer we go*, we infer the eye to be too long (myopic); if we only see the optic disk distinctly, after having approached the eye to within about three-quarters of an inch, we consider the eye to be normal in shape (emmetropic), or but very slightly myopic, or hypermetropic.

This method of ascertaining the refraction, though not equal, as regards accuracy, to the one obtained by examination with spherical, etc., lenses, is the quickest means of furnishing the key to the state of refraction in moderate and in higher degrees of ametropia, and should be well practised.

The observer's eye, for this and the indirect ophthalmoscopic examination, if not emmetropic, should be made so, by placing that spherical lens, which corrects the faulty refraction, behind the sight-hole of the ophthalmoscope.

The optic disks of emmetropic and of hypermetropic eyes can readily be examined directly. The optic disk of the myopic eye requires the concave lens, which corrects the myopia, to be placed behind the sight-hole of the ophthalmoscope.

On approaching with the ophthalmoscope to within about an inch from the patient's eye, we distinctly see the entire optic disk, or part of it, its vessels, and part of the adjoining tunics. The patient's cornea and crystalline lens act, in this case, as a strong magnifying lens. The optic disk often appears so much enlarged, that, though the pupil be dilated to its utmost, we cannot overlook the entire disk at once; but, to do so, have to look into the eye from different directions.

The direct mode of examination, besides assisting us in determining the shape and refraction of the eye, admits of our seeing the details of the optic disk, and of the tunics near it, better, more quickly, and more easily than any other method.

Having seen the optic disk, we inspect the tunics, by looking in different directions through the pupil.—[Bader.

OINTMENTS.

Ointments of one part of the yellow amorphous oxide of mercury to eight parts of lard, as they have recently been recommended (Pagenstecher), act too severely, and require subsequent cleansing of the conjunctival sac. The amorphous yellow oxide has one unpleasant property, and that is, it readily decomposes when exposed to light; therefore, it should be carefully protected and frequently renewed. The ointment should be thoroughly rubbed up, so that one part does not act more powerfully than the other. Recently, instead of the lard, a mixture of one part of starch with five parts of glycerine has been used. By soaking the former in glycerine, heated up to 70° R. (about 190° F.), the mixture attains the consistency of lard. It does not become rancid like lard, however, which then does harm and decomposes the preparation. Most of the agents used in eye-salves are readily soluble in glycerine. Besides, the glycerine itself deliquesces in the tears, and the medicaments enveloped in it are more easily disturbed throughout the whole conjunctival sac, and thus are more certainly taken up, than when applied in the ointments made with lard, which the moist conjunctiva, as it were, throws off. Therefore, glycerine ointments, containing the same amount of the active substance, have almost double the effect of the others. The glycerine used should be chemically pure, perfectly colorless, and as clear as water.—[GRÆFE.

TERMS OF CLASSIFICATION OF MEDICINES.

Narcotics are substances which diminish the actions and powers of the system, without occasioning any sensible evacuation. They have the effect of producing sleep.

Antispasmodics are medicines which have the power of allaying irritations and spasms.

Tonics are those articles which increase the tone of the animal fibre, by which strength is given to the system.

Astringents are articles which have the power of binding or contracting the fibres of the body.

Emetics are medicines which excite vomiting, independent of any effect arising from the mere quantity of matter introduced into the stomach.

Purgatives, or Cathartics, are medicines which increase the peristaltic motion of the intestines, and thereby produce a preternatural discharge.

Emmenagogues are those medicines which are capable of promoting the menstrual discharge.

Diuretics are those medicines which increase the urinary discharge.

Diaphoretics are those medicines which increase the natural exhalation by the skin, or promote moderate perspiration.

Sudorifics are those medicines which produce copious exhalations or sweating.

Expectorants are those medicines which increase the discharge of mucus from the lungs.

Sialogogues are those medicines which excite a preternatural flow of saliva.

Errhines are those medicines which increase the secretion from the nose and head, and excite sneezing.

Epispastics, or Blisters, are those substances which, when applied to the surface of the body, produce a serous or puriform discharge, by exciting a previous state of inflammation.

Rubefacients are substances which, when applied to the skin, stimulate, redden, or inflame it.

Refrigerants, medicines which allay the heat of the body or of the blood.

Antacids, remedies which obviate acidity in the stomach.

Lithontriptics, medicines which are supposed to have the power of dissolving urinary concretions in the bladder.

Escharotics, or Caustics, substances which corrode or dissolve the animal solids.

Anthelmintics, medicines which have the effect of expelling worms from the intestines.

Demulcents, medicines which obviate and prevent the action of stimulating and acrid substances, by involving them in a mild and vascid matter, which prevents their action on the body.

Diluents, those medicines which increase the fluidity of the blood.

Emollients, substances which soothe and relax the living fibre.

Alteratives. This term is applied to substances which are found to promote a change in the system favorable to recovery from disease, but not with certainty referable to any other class.

Counter-irritants, agents applied to the surface, which excite an eruption or an inflammation, and thus divest the humors from the internal to the external parts.

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TEST TYPES.

No. 1—Diamond.

Though, in the choice of spectacles, every one must finally determine for himself which are the glasses through which he obtains the most distinct vision; yet, some confidence should be placed in the judgment of the artist of whom they are purchased, and some attention paid to his directions. By trying many spectacles, the eye is fatigued, as the pupil varies in size with every different glass; and the eye endeavors to accommodate itself to every change that is produced. Hence, the purchaser often fixes upon a pair of spectacles, not the best adapted to his sight, but those which seem to relieve him most, while his eyes are in a forced and unnatural state; and, consequently, when he gets home, and they are returned to their natural state, he finds what he had chosen fatiguing and injurious to his sight.

No. 2—Pearl.

Increasing years have a natural tendency to bring on the defect, and earlier among those who have made the least use of their eyes in their youth; but, whatever care be taken of the sight, the decays of nature cannot be prevented: the humors of the eye will gradually waste and decay; the refractive coats will become flatter; and the other parts of the eye more rigid, and less pliable: thus, the latitude of distinct vision will become contracted: it is also highly probable that the retina and optic nerve lose a portion of their sensibility.

Though it is in the general course of nature that this defect should augment with age, yet there are not wanting instances of those who have recovered their sight at an advanced period; and have been able to lay aside their glasses, and read and write with pleasure, without any artificial assistance.

Among many causes which may produce this effect, the most probable is, that it generally rises from a decay of the fat in the bottom of the orbit; the pressure in this part ceasing, the eye expands into somewhat of an oval form; and the retina is removed to a due focal distance from the crystalline.

No. 3—Nonpareil.

Though it is in the general course of nature that this defect should augment with age, yet there are not wanting instances of those who have recovered their sight at an advanced period; and have been able to lay aside their glasses, and read and write with pleasure, without any artificial assistance.

Among many causes which may produce this effect the most probable is, that it generally arises from a decay of the fat in the bottom of the orbit; the pressure in this part ceasing, the eye expands into somewhat of an oval form; and the retina is removed to a due focal distance from the crystalline.

No. 4—Minion.

We are now able to decide upon a very important question, and say how far spectacles may be said to be *preservers of the sight*. It is plain they can only be recommended, as such, to those whose eyes are beginning to fail; and it would be as absurd to advise the use of spectacles to those who feel none of the foregoing inconveniences, as it would be for a man in health to use crutches, to save his legs. But those who feel those inconveniences, should immediately take to spectacles; which by enabling them to see objects nearer, and by facilitating the union of the rays of light on the retina, will support and preserve the sight.

No. 5—Long Primer.

Many are the advantages that are derived from our having two eyes—some that are known, others that are unknown; for the correspondence of the double parts of the human frame, and their relation to the two great faculties of the human mind, has not been sufficiently attended to by anatomists. By having two eyes, the sight is rendered stronger, and the vision more perfect; for, as each eye looks upon the same object, a more forcible impression is made, and a livelier conception formed by the mind.

No. 6—Small Pica.

Some refrain from the use of glasses who really require their aid, from the belief that if they once begin to use them, they will never be able to leave them off. In the great majority of cases this is perfectly true; but, even then, it is better to submit with a good grace to an affliction which can seldom be averted, and to have recourse to those simple means which at once set the eye at ease, and enable its possessor to enjoy many hours of comfort and rational employment, which would otherwise be lost.

No. 7—Pica.

The color and consistence of this humor alter with age; it becomes thicker, cloudy, and less transparent, as we advance in years; which is one reason, among others, why many elderly people do not reap all that benefit from spectacles which they might naturally expect.

No. 8—English.

By a MEDIUM, in the language of opticians, is meant any transparent substance, solid or fluid, through which light passes.

No. 11.

By a medium, in the language of opticians, is meant any transparent substance, solid or fluid, through which light passes.

No. 12.

Whatever is seen or beheld by the eye, is by opticians called an object.

No. 13.

Whatever is seen or beheld by the eye, is by opticians called an object.

No. 14.

One medium is said to be more

No. 15.

Dense than another when

No. 16.

Contains more
in same bulk

No. 17.

And Size
than ones

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